Service Guide

Anesthetic Gas Module

M1026B

Patient Monitoring

PHILIPS

Part Number M1026-9020A
Reordering Number: 453563499691

PHILIPS

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1

Introduction

This chapter contains the following information on the M1026B Anesthetic Gas Module:

- A description of the Module, including its physical, environmental and performance specifications
- A general explanation of the measurement principles that the Module uses to measure gas concentrations
- The theory of operation of the Module, its components and how they work.

Description

The Philips M1026B Anesthetic Gas Module works together with the IntelliVue MP40/50/60/70/90 and the ACMS and V24/26 patient monitors through an RS232 serial interface. It measures the airway gases of ventilated patients who are under general gas anesthesia, or emerging from it.

The module produces graphical wave data, and inspired and end-tidal numeric data for the following gases:

- CO_2
- N_2O
- One volatile anesthetic agent
- O_2

It also generates a numeric for the patient's airway respiration rate (AWRR).

The Agent Identification feature identifies which anesthetic agent is being used.

Physical Specifications

Size (H x W x D):	90mm x 370mm x 467mm (3.54 x 14.6 x 18.4 in)
Weight:	6.3 kg (13.9 lb)

Environmental Specifications

Operating Temperature:	10 to 40°C (50 to 104°F)
Storage Temperature:	-20 to 70°C (-4 to 158°F)
Humidity Limit (Operating):	up to 95% RH max @ 40 °C (104 °F). non-condensing
Humidity Limit (Storage):	up to 95% RH max @ 70°C (158 °F). non-condensing
Altitude Range (Operating):	-381 to 3048m (-1,250 to 10,000 ft)
Altitude Range (Storage):	-305 to 5,486m (-1,000 to 18,000 ft)
Warm-up Time:	Full Accuracy after selftest is finished (max. 2 min)

Performance Specifications

All Performance and accuracy specifications are valid based on gas sample tubing M1658A, including watertrap M1657B, and airway adapter 13902A.

Humidity Correction: For CO_2 the humidity correction can be set to “wet” or “dry”.

Wet: p [mmHg] = c [Vol%] * (p_abs - p_H_2O)/100

Dry: p [mmHg] = c [Vol%] * p_abs /100

Where p = partial pressure, c = gas concentration, p_abs = pressure in breathing circuit, p_H_2O = 47 mmHg, partial pressure of water vapor of exhaled gas (37 ^oC, 100% rh).

For all other gases the readings are always given as dry values.

Sample Flow Rate*:* 150 ml/min.

Sample Delay Time: All measurements and alarms are subject to a delay of 3 seconds.

Total System Response Time = the sum of the delay time and the rise time.

CO_2 Measurement

Range:	0 to 76 mmHg
Accuracy:	± 1.5 mmHg (0 - 30 mmHg) ± 5 rel. % (30 - 76 mmHg)
Resolution:	1 mmHg
Rise-time:	410 msec typical

The total system response time is the sum of the sample delay time (3 seconds) and the rise time (410 msec typical)

AWRR derived from CO_2 Waveform

Range:	0 to 60 rpm
Accuracy:	± 2 rpm
Resolution:	1 rpm
Detection Criteria:	6 mmHg variation in CO_2

N_2O Measurement

Range:	0 to 85 vol%
Accuracy:	± 1.5 vol% + 5% relative
Resolution:	1 vol%
Rise-time:	510 msec typical

O_2 Measurement

Range:	0 to 100vol%
Accuracy:	± 3 vol%
Resolution:	1 vol%
Rise-time:	640 msec typical

Anesthetic Agent Measurement

Agent	Range (vol%)	Accuracy	Resolution	Rise Time
Halothane	0 - 7.5	± (0.1 vol% + 4.0% relative)	0.05	< 900
Enflurane	0 - 7.5	± (0.1 vol% + 4.0% relative)	0.05	< 620
Isoflurane	0 - 7.5	± (0.1 vol% + 4.0% relative)	0.05	< 610
Sevoflurane	0 - 9.0	± (0.1 vol% + 4.0% relative)	0.05	< 570
Desflurane	0 - 20.0	± (0.1 vol% + 4.0% relative	0.05(0-10) 0.1 (10.1-20)	< 540

Alarm Ranges

Agent	High Range	Low Range
AWRR	10 - 60 rpm	0 - 59 rpm
$ETCO_2$	20 - 76 mmHg	10 - 75 mmHg

Agent	High Range	Low Range
$IMCO_2$	2 - 20 mmHg	none
inN_2O	0 - 82 vol%	none
inO_2	19-100 vol%	18 - 99 vol%
et SEV	0.1 - 9.0 vol%	0.0 - 8.9 vol%
in SEV	0.1 - 9.0 vol%	0.0 - 8.9 vol%
et DES	0.2 - 20.0 vol%	0.0 - 19.8 vol%
in DES	0.2 - 20.0 vol%	0.0 - 19.8 vol%
Halothane, Enflurane, Isoflurane		
et	0.1 - 7.5 vol%	0.0 - 7.4 vol%
in	0.1 - 7.5 vol%	0.0 - 7.4 vol%

Alarm Delay

10 seconds if no automatic zero calibration occurs within that time.

Apnea Alarm

Delay Range:	10 - 40 seconds
Criterion	No detected breath within the adjusted delay time
Alarm:	Within 2 seconds after this criterion is met, if no automatic zero occurs

INOP Alarms

INOP alarms are triggered if:

- The Philips M1026B Anesthetic Gas Module is disconnected or switched off.
- The equipment malfunctions.
- Zero calibration has failed.
- Zero calibration is in progress.
- The gas sample tube is occluded, or the water trap is full.
- The Philips M1026B Anesthetic Gas Module is unable to measure.
- Gas contaminant is detected.
- Agent mixture detected.
- Anesthetic agent detected but not selected.
- The module is in self-test.
- No breath detected.

General Measurement Principles

The M1026B Anesthetic Gas Module uses a technique called Dispersive Infrared (DIR) absorption to measure the concentration of certain gases. The gases measured by the M1026B Anesthetic Gas Module (except oxygen) absorb infrared (IR) light and each gas has its own absorption characteristic.

The gas is transported into a sample cell. A diffraction grating is used to scan the relevant wavelength range of the IR light that passes through the sample cell. The higher the concentration of gas the more IR light is absorbed, and from the amount of IR light measured, the concentration of gas present can be calculated.

Individual gases have an individual spectral fingerprint. A mathematical algorithm is used to analyze the spectrum and to identify and quantify the anesthetic agents in the gas.

Oxygen is measured by an additional sensor in the M1026B Anesthetic Gas Module using its paramagnetic properties.

Theory of Operation

Figure 1 shows the functional blocks within the Philips M1026B Anesthetic Gas Module.

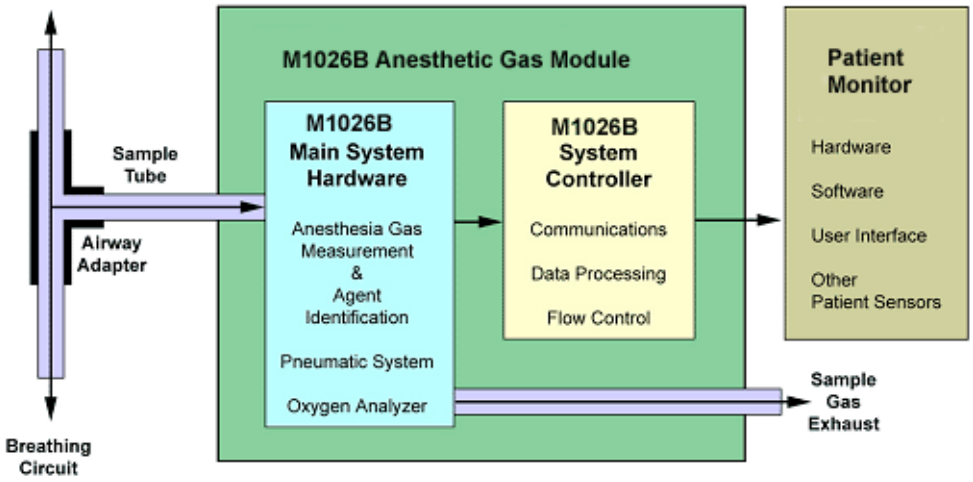


Figure 1 Anesthetic Gas Module Functional Block Diagram

The main components of the Philips M1026B Anesthetic Gas Module are:

- Main PC Board.
- Power Supply.
- Pneumatic Assembly.
- O_2 Sensor.

- DIR optics.

Main PC Board

The electronics subsystem, with memory (FLASH & RAM), multiplexers, A-D converter, and power line supervision, is responsible for the following functions:

- The acquisition and processing of data from, and control of, the anesthesia gas measurement analyzer.
- The acquisition and processing of data from the oxygen analyzer.
- Controlling the pneumatic system.
- Controlling the communications between the M1026B and the host monitoring system.

The M1026B electronics subsystem has one communications channel, connected to an external RS232 port.

The M1026B functionality is controlled by Flash Memory resident software.

Power Supply

The input voltage is 100V - 240V. The output voltages are ±12V and +3.3V.

Pneumatic System

The main parts of the pneumatic system are:

- Watertrap.
- Pneumatics assembly including:
  - pump outlet filter
  - two flow restrictors
  - four bacterial filters
  - three solenoid valves
  - dampening volumes
- Pump

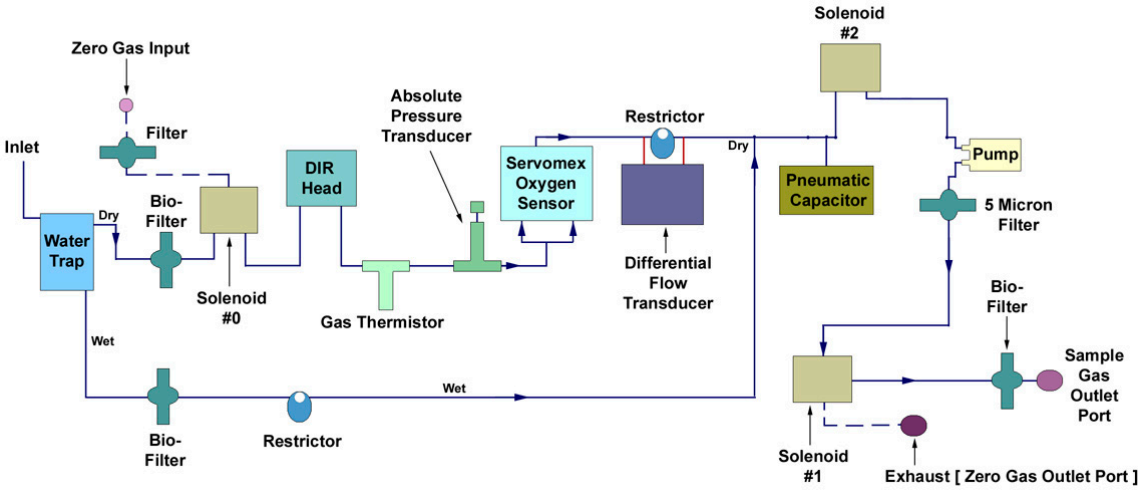


Figure 2 Pneumatic System

The pneumatic system works in the following way:

1 Eliminates residual water and fluids from patient sample gas using the watertrap.

2 Splits the patient's sample gas flow (150ml/min) into the measurement path (120ml/min) and drainage path (30ml/min).

3 Passes the patient's sample gas in the measurement path at 120ml/min through the measurement bench (O2 analyzer, DIR Head).

4 Delivers zero calibration gas to the sample cells for the periodic zeroing.

5 Exhausts the patient's sample gas, the zero calibration gas, and the span calibration gas.

6 Monitors for an occlusion in the sampling pneumatics.

Pump

The software-controlled pump generates the flow through the system and pulls the gas from the airway adapter through the measurement subsystems to the exhaust outlet. It also delivers the zero calibration gas to the sample cells of the measurement subsystems for the periodic zero procedures and it exhausts the patient's sample gas, the zero calibration and field calibration gases.

The flow-rate control logic drives the pump as hard as necessary to maintain the selected flow rate. A partial occlusion or an inefficient pump results in the pump being driven harder. A serious occlusion results in the pump being driven at or near its maximum load. This triggers a logic, which then reports an occlusion.

Watertrap

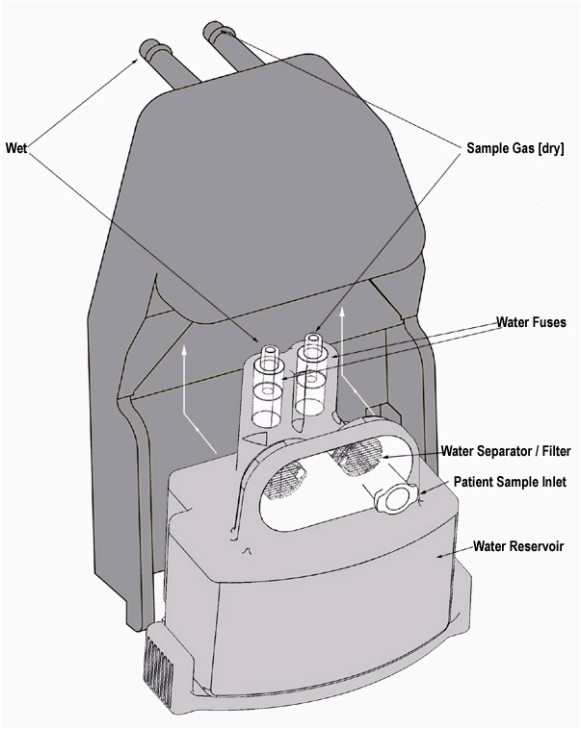


Figure 3 Watertrap

The watertrap consists of two water separation filters, two water fuses and a water reservoir. The gas sample coming from the patient may contain fluids which are separated from the gas at the first water separation filter. The gas is then split into two paths, the “measurement” path with the main part of the total gas flow (including water vapor) continuing on the “dry” side of the separation filter and the “drainage” path (containing any liquid droplets) with the smaller amount of the total flow continuing on the “wet” side of this filter through the water reservoir. At the pump both gas paths are recombined.

The watertrap proper includes “water fuses” in both the “measurement” and the “drainage” paths, consisting of a material that swells when getting wet (when the reservoir is full or when fluid penetrates the separation filter and enters the “measurement” path) and blocks the respective path at the inlet of the unit. Once the “water fuses” are blown, any passage of fluid is blocked and the gas flow resistance increases so that an occlusion is detected.

Sample Flow Through the Pneumatic Path

The drainage path serves to withdraw fluid separated at the first water separation filter from the gas sample into the watertrap reservoir.The drainage path leads into the large watertrap reservoir where all liquid water and other fluids are collected. When the drainage path leaves the watertrap through a water separation filter and a through a water fuse it leads through a bacterial protection filter and flow restrictor directly to the pump. This flow restrictor determines the percentage distribution between drainage and measurement path flow.

The measurement path leads through the first water separation filter and through a water fuse on into the measurement system. The patient sample gas (on the measurement path) then flows through a bacterial protection filter to solenoid valve #0. Room air for the zero calibration is alternatively input (via a filter) to this solenoid valve. The solenoid valve switches between the two gases depending on the current mode of operation - normal measurement or zero calibration.

The patient sample gas or zero calibration gas then flows through the measurement subassemblies:

- the DIR Measurement Assembly (for measurement of anesthetic agent, CO_2 and N_2O)
- the O_2 cell

From here it is passed to the flow sensor which consists of a differential pressure transducer and a flow restrictor. The flow sensor determines, stabilizes and limits the flow rate of the sampled gas.

Then the patient sample gas or zero calibration gas flows to the pump. Before reaching solenoid valve #2 and the pump, it joins the drainage path again.

After the gas has passed through solenoid valve #1 it is routed through a filter to the Sample Gas output. Alternatively, the zero gas is output to the zero gas outlet port by this solenoid valve.

O_2 Sensor

Specifications

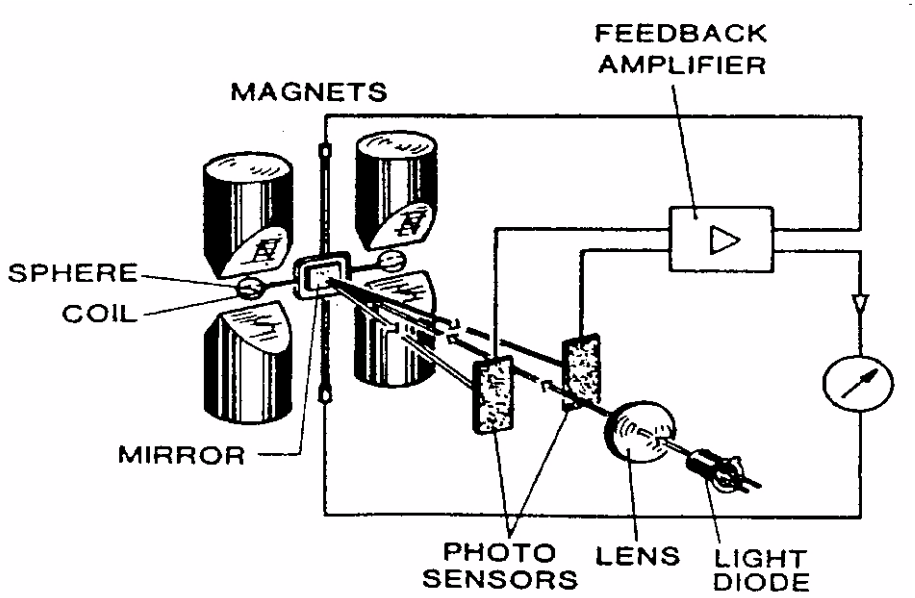
Weight	150 g
Size (HxWxD)	65 x 30 x 65 mm

Measurement Principle

The O_2 sensor uses a fast O_2 measurement technique that utilizes O_2 paramagnetic properties.

Two sealed spheres are filled with N_2 and mounted on a rotating suspension within a magnetic field. A mirror is mounted centrally on the suspension and light is shone onto the mirror. The reflected light is directed onto a pair of photocells. Oxygen attracted into the magnetic field displaces the nitrogen filled spheres, causing the suspension to rotate. The photocells detect the movement and generate a signal.

The signal generated by the photocells is passed to a feedback system which passes a current around a wire mounted on the suspension. This causes a motor effect which keeps the suspension in its original position. The current flowing around the wire is directly proportional to the concentration of oxygen within the gas mixture.



The DIR Head Assembly

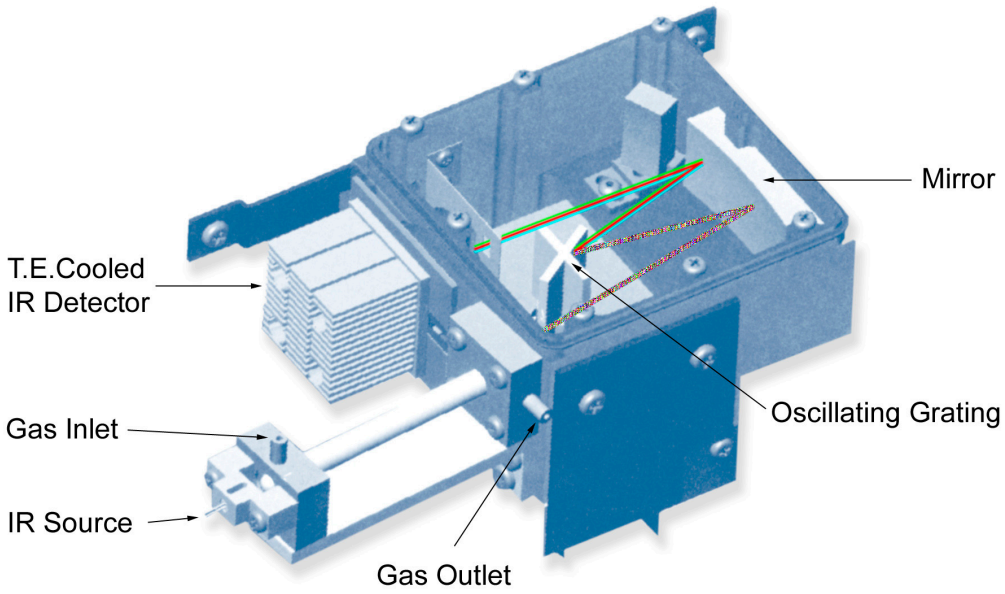


Figure 4 Anesthetic Gas Module DIR Head Assembly

The DIR head functions as follows:

The infrared light source is a tungsten filament lamp.

The Anesthetic Gas Module sample cell is constructed of a glass tube with a highly reflective gold coated internal surface that serves as a light pipe. The sample cell length is designed to provide an adequate absorption length to obtain the desired signal-to-noise ratio for the weakest anticipated absorption. Sapphire serves as the sample cell window material for the two ends of the sample cell.

The gas sample to be analyzed enters the sample cell through the gas inlet and leaves it through the gas outlet. While in the cell, the gas sample is penetrated by light from the infrared light (IR) source. This light is dispersed via a single diffraction grating. The attached brushless DC rotary actuator working in tune with an encoding mechanism ensures that the grating is always in the correct position. The dispersed light is reflected by a mirror and lastly hits a dual filter/detector package.

Software then takes the data from the scan of the dispersed component wavelengths to produce a characteristic curve, its shape determined by the relative concentrations of different gases in the sample.

A thermistor in the outlet gas stream measures the sample gas temperature. A transducer measures sample gas pressure. Knowledge of sample gas pressure and sample gas temperature is vital for accurate gas measurements.

Zero calibration capability is provided to maintain long-term, stable gas concentration measurement.

2

Installation and Patient Safety

This chapter describes how to install the Philips M1026B Anesthetic Gas Module. It details the operating environment required by the Philips M1026B Anesthetic Gas Module as well as instructions on how to affix the local language labels and physically connect it to the monitor. Next, the patient safety information is detailed. Finally, this chapter describes the software setup required and any post-installation checks that have to be performed before using the Philips M1026B Anesthetic Gas Module together with a reminder of the preventive maintenance (PM) checks and their frequencies.

Physical Installation

This section describes the operating and storage environment for the Philips M1026B Anesthetic Gas Module, affixing the local-language labels, connecting to the monitor, and fitting the gas exhaust return system.

CAUTION The Philips M1026B Anesthetic Gas Module must be positioned horizontally on a level surface. To avoid condensed water collecting in the patient sample tube, it is recommended that the Philips M1026B Anesthetic Gas Module is positioned at or above patient level, wherever possible.

Environment

WARNING Possible explosion hazard if used in the presence of flammable anesthetics.

The environment where the Philips M1026B Anesthetic Gas Module is used should be free from vibration, dust, corrosive or explosive gases, and extremes of temperature and humidity.

For a cabinet mounted installation with the monitor, allow sufficient room at the front for operation and sufficient room at the rear for servicing with the cabinet access door open.

The Philips M1026B Anesthetic Gas Module operates within specifications at ambient temperatures between 15°C and 40°C, 2 minutes after switching it on.

Ambient temperatures that exceed these limits could affect the accuracy of this instrument and cause damage to the components and circuits. Allow at least 2 inches (5cm) clearance around the instruments for proper air circulation.

CAUTION If the Philips M1026B Anesthetic Gas Module has been stored at temperatures below freezing, it needs a minimum of 4 hours at room temperature to warm up before any connections are made to it.

Make sure that the Philips M1026B Anesthetic Gas Module is free of condensation before operation. Condensation can form when equipment is moved from one building to another, thus being exposed to moisture and differences in temperature.

Making Connections to the AGM

All connections to the AGM are made on its rear panel. Refer to Figure 5.

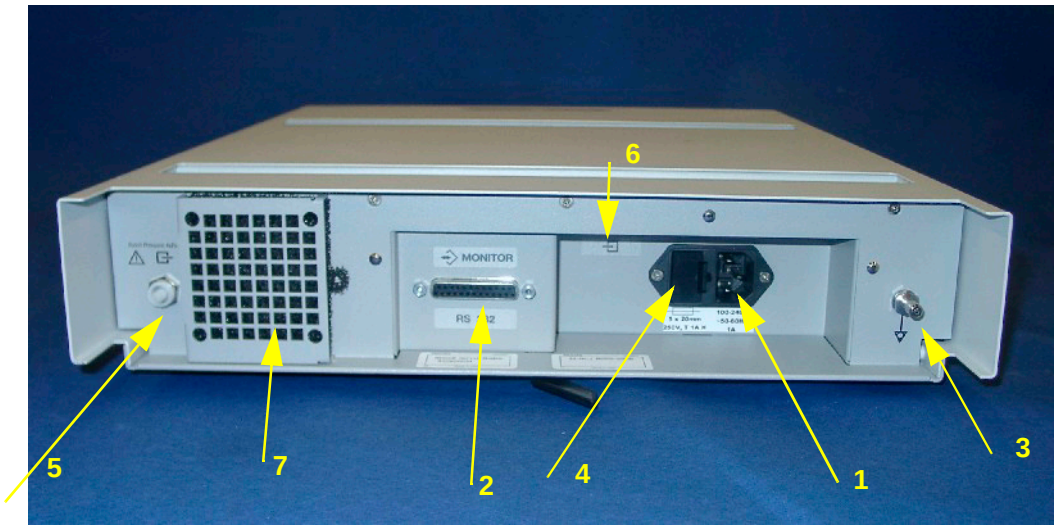


Figure 5 The Rear Panel

1 Local power connector; this is a 3-pin connector, used to connect the AGM to the local line voltage supply.

The Anesthetic Gas Module can be operated from an ac power source of 100 - 240 V ± 10%, 50/60 Hz. The adjustment is made automatically by the power supply inside the module.

2 RS232 Connector (RS232 Interface); this is a 25-pin “D” type connector, used to connect the AGM to the monitor.

The connection to an IntelliVue patient monitor can be made with the following cables:

– M1026B#K11 1 m (M1026-61001)
– M1026B#K12 3 m (M1026-61002)
– M1026-61003 10 m

The connection to an ACMS patient monitor can be made with the following cables:

– M1181A#A52 or M1026B#K01 1 m (M1181-61658)
– M1181A#A51 3 m (M1181-61632)
– M1181A#A5A 10 m (M1181-61630)

The connection to a V24/V26 patient monitor can be made with the following cable:

– M1204-60192 (1.2 m)

3 Equipotential Grounding Terminal; this is used to connect the AGM to the hospital's grounding system.

4 Line protection fuses, T1 A H 250V.

5 Anesthetic gas exhaust. If N_2O and/or other inhalation anesthetics are used during anesthesia, pollution of the operating room should be prevented. Once the gas sample has passed through the AGM, it should either be **returned to** or **removed from** the anesthesia circuit.

6 Zero Gas Exhaust

7 Fan Filter

Connections to the Sample Gas Exhaust

Returning the Gas Sample

You will need the following equipment to **return** the gas sample to the anesthesia circuit:

Equipment	Part Number	Comments
Gas Exhaust Return Line	M1655A	Tubing includes two parts: Tube A = 50cm long Tube B = 3m long
Gas Exhaust Return Filter	M1656A	Single patient use only

NOTE The M1655A may not be available in all countries.

Setting Up the Gas Return

(see diagram Figure 6)

1 Fit the **male** luer lock connection (2) of the **shorter** tube, to the **female** side of the M1656A Gas Exhaust Return Filter.

2 Fit the **female** luer lock connection (3) of the **longer** tube, to the **male** side of the M1656A Gas Exhaust Return Filter.

3 Fit the open end (7) of the **longer** tube to the AGM's Anesthetic Gas Exhaust.

4 Fit the open end (5) of the **shorter** tube to the ventilation circuit.

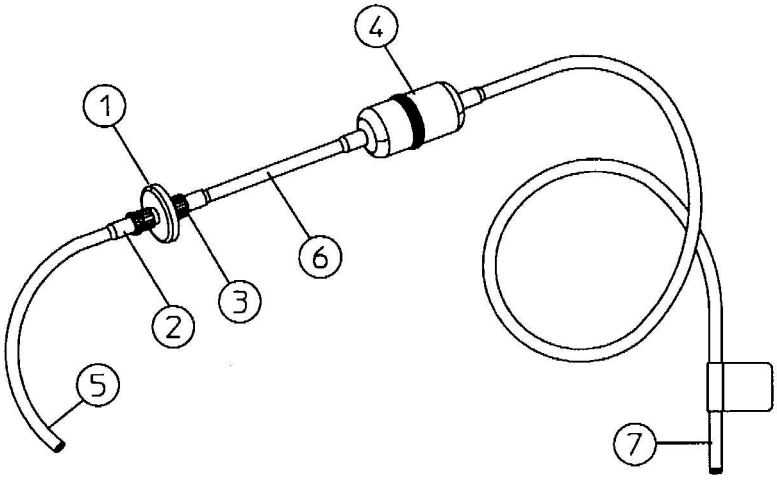


Figure 6 Setting Up the M1655A Gas Exhaust Return Line

1 M1656A Gas Exhaust Return Filter

2 Female luer lock

3 Male luer lock

4 Dampener

5 Shorter tube

6 Connecting tube

7 Longer tube - connected to AGM exhaust port

Removing the Gas Sample

To **remove** the gas sample from the anesthesia circuit, a scavenging system needs to be connected to the AGM's Anesthetic Gas Exhaust. If you intend to use a scavenging system with the AGM, one of the following parts must also be connected to protect it against malfunction:

1 A ventilator reservoir where the suction pressure does not exceed 0.3-0.4 mmHg or

2 A scavenging interface, properly set and maintained (see scavenging interface manufacturer's instructions).

Setup and Configuration Procedures

This section describes final setting up and configuration procedures that must be completed after the AGM is connected to the monitor and switched on before the AGM is used for monitoring.

Altitude Configuration

The altitude setting for the monitor is important as it is used as a reference to check the AGM ambient pressure measurement.

See your monitor service guide for details.

Connect Sample Input Tubing

Connect the sample input tubing to the watertrap at the luer lock connector. For details, refer to the Instructions for Use.

Post-Installation Checks

See Test and Inspection Matrix for details.

WARNING Do not use the instrument for any monitoring procedure on a patient if you identify anything which indicates impaired functioning of the instrument.

Safety Requirements Compliance and Considerations

The Philips M1026B Anesthetic Gas Module complies with the following international safety requirements for medical electrical equipment:

- UL 2601-1
- IEC-60601-1
- CSA C22.2 No. 601.1-M90
- EN 60601-1
- EN 60601-1-2

Explanation of Symbols Used

	Attention, consult accompanying documents.
	Indicates that the instrument is type CF and is designed to have special protection against electric shocks (particularly regarding allowable leakage currents, having an F-Type isolated (Floating) applied part), and is defibrillator proof.
	A gas output.
	A gas input.

	Equipotential grounding terminal.
	RS232 communication port.
	Fuse.
	Protective earth ground.
	Electrical shock hazard.

The Anesthetic Gas Module is protected against the effects of defibrillation and electrosurgery.

Power Supply Requirements

The system and the Anesthetic Gas Module can both be operated from an AC supply of 100 - 240V ±10%, 50 - 60Hz.

Grounding the System

To protect the patient and hospital personnel, the cabinet of the installed equipment has to be grounded. The equipment is supplied with a detachable 3-wire cable which grounds the instrument to the power line ground (protective earth) when plugged into an appropriate 3-wire receptacle. If a 3-wire receptacle is not available, consult the hospital electrician.

WARNING Do not use a 3-wire to 2-wire adapter.

Equipotential Grounding

Protection class 1 instruments are already included in the protective grounding (protective earth) system of the room by way of grounding contacts in the power plug. For internal examinations on the heart or the brain, Computer Module and Display Module of the System and the Philips M1026B Anesthetic Gas Module must have separate connections to the equipotential grounding system.

One end of the equipotential grounding cable (potential equalization conductor) is connected to the equipotential grounding terminal on the instrument's rear panel and the other end to one point of the equipotential grounding system. The equipotential grounding system assumes the safety function of the protective grounding conductor if ever there is a break in the protective grounding system.

Examinations in or on the heart (or brain) should only be carried out in rooms designed for medical use incorporating an equipotential grounding system.

Combining Equipment

If it is not evident from the instrument specifications whether a particular instrument combination is hazardous or not, for example, due to summation of leakage currents, the user should consult the manufacturers concerned or an expert in the field, to ensure that the necessary safety of all instruments concerned will not be impaired by the proposed combination.

3

Checking and Calibrating the Anesthetic Gas Module

This chapter explains how to check the Anesthetic Gas Module to ensure that it is operating within its specified limits. A list of the equipment required to carry out the checks is included, as well as step-by step instructions for the calibrations.

If you receive fail indications while testing, refer to the troubleshooting section of this document for guidance. If you are instructed to remove or replace parts of the Anesthetic Gas Module refer to the respective section.

Access Service Functions of the M1026B Anesthetic Gas Module

Service functions of the M1026B Anesthetic Gas module are accessed with the M1026B Service Software which is available on the Service Guide CD shipped with the product.

When and how to check the Philips M1026B Anesthetic Gas Module

To ensure that the Philips M1026B Anesthetic Gas Module operates with the specified limits, it must be checked:

1 Every 12 months ***or*** if the measurements are in doubt.

2 After repairing the AGM

If you find values outside the tolerance limits while checking, the Philips M1026B Anesthetic Gas Module must be repaired.

The basic steps to check the Philips M1026B Anesthetic Gas Module are:

1 Connect a PC/Laptop running the M1026B Service Software to the Anesthetic Gas Module and wait for the first zero calibration after the startup period.

2 Perform:

   a. a leakage check

   b. a flowrate check

   to ensure that there are no leaks in the gas system and that the flowrates are set correctly.

3 Perform Zero calibration.

4 Check that there are no reported errors.

5 Check the Span calibration of gases.

WARNING Only perform Zero and Span calibration checks when the top cover is closed. Light and electro-magnetic interference can affect the measurements.

Equipment required for checking

The following equipment is required for checking the AGM. Part numbers are given in the Parts List section.

1 Electronic Flowmeter M1026-60144 (Instructions are provided with the flowmeter. See also Service Note M1026A-034).

2 Span Check Equipment.

- Check Gas (M1662A).
- Calibration Tubing (M1659A).
- Luer lock plug available on the elbow airway adapter (13902A).

3 Flow Split Test Fixture (M1026-60136)

Checks and adjustments

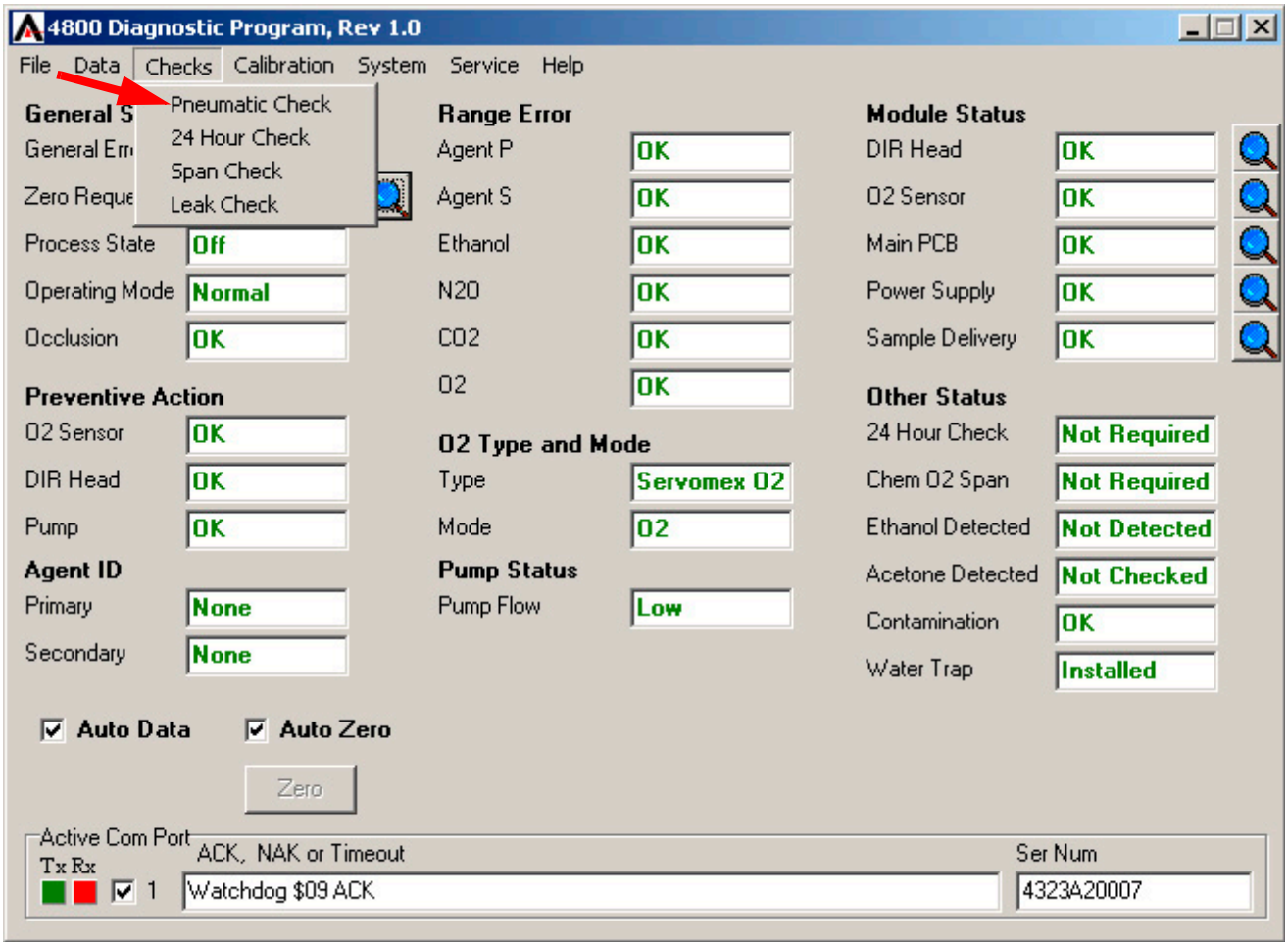
The following sections explain the steps needed to carry out the checks and adjustments. A complete check and calibration procedure requires approximately 30 minutes, including waiting time.

NOTE Make sure that the watertrap is attached.

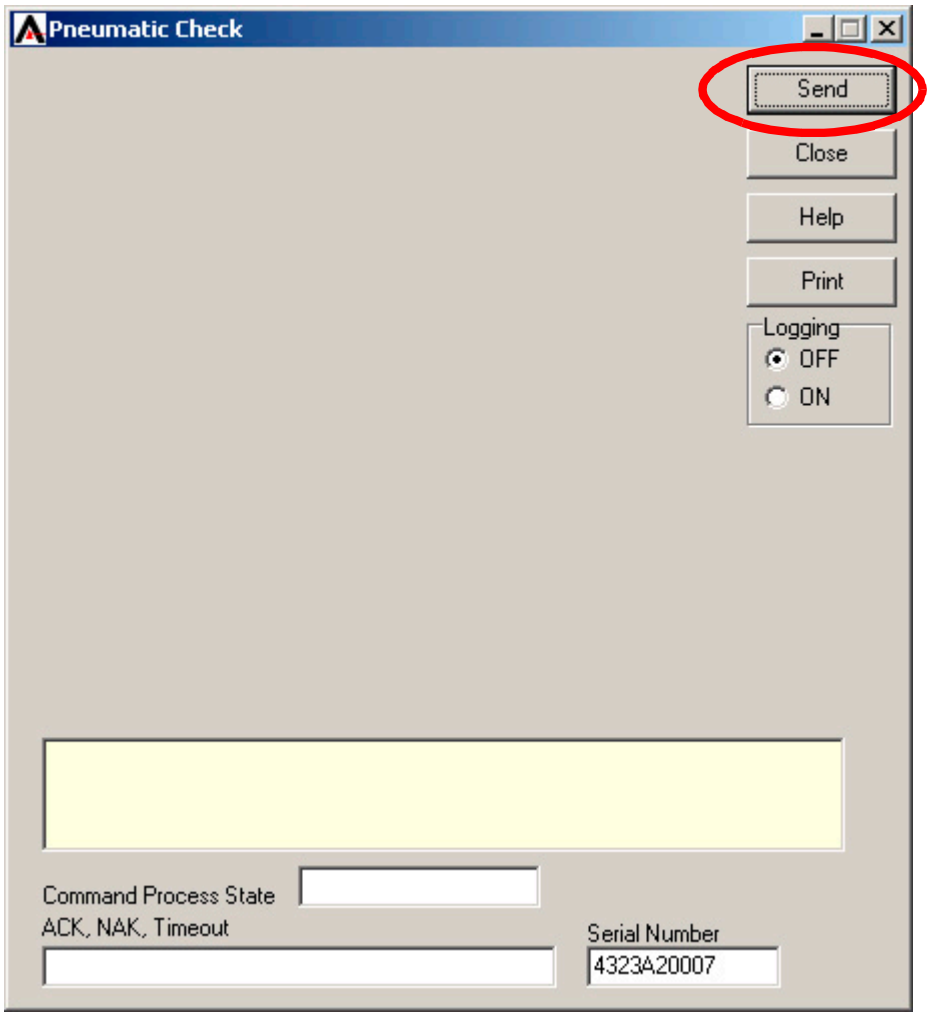
Pneumatic Check

Always perform a pneumatic check before performing a leak check or before retrieving a temperature or ambient air pressure reading.

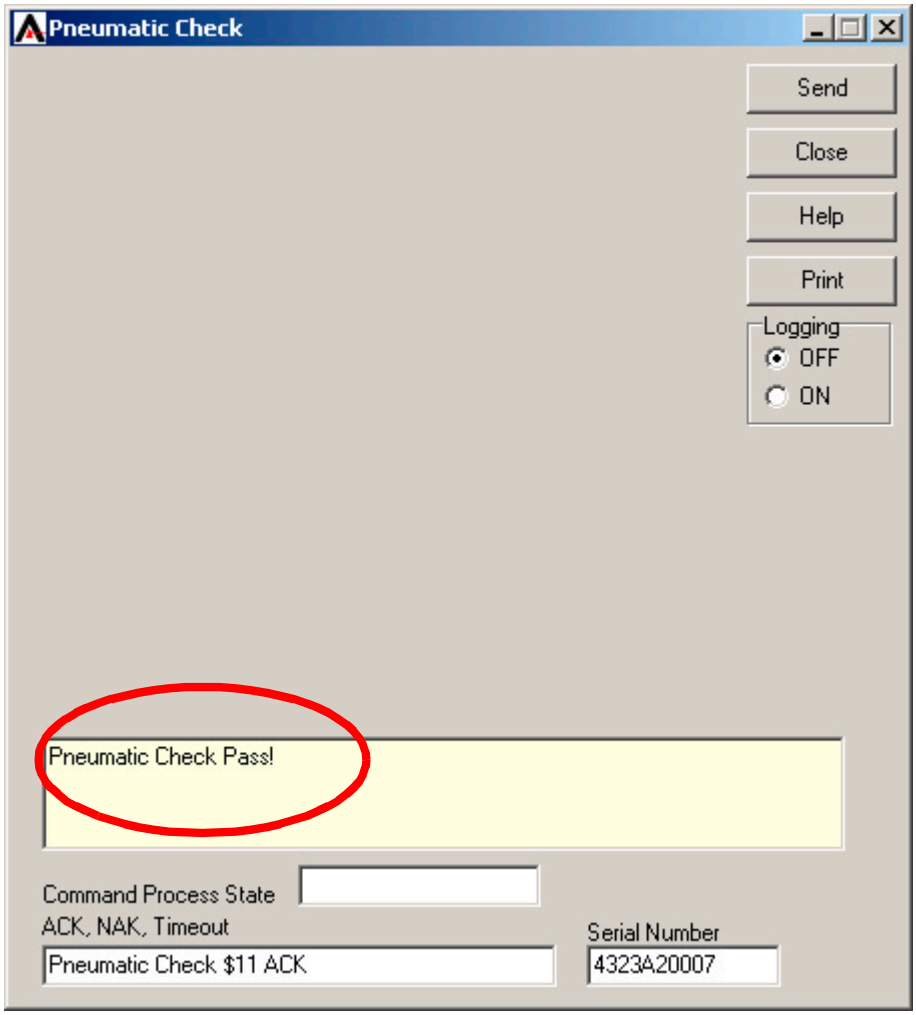
1 Select **`Pneumatic Check`** from the Checks pull-down menu.



2 Click on Send.



3 Wait for the “passed” message.

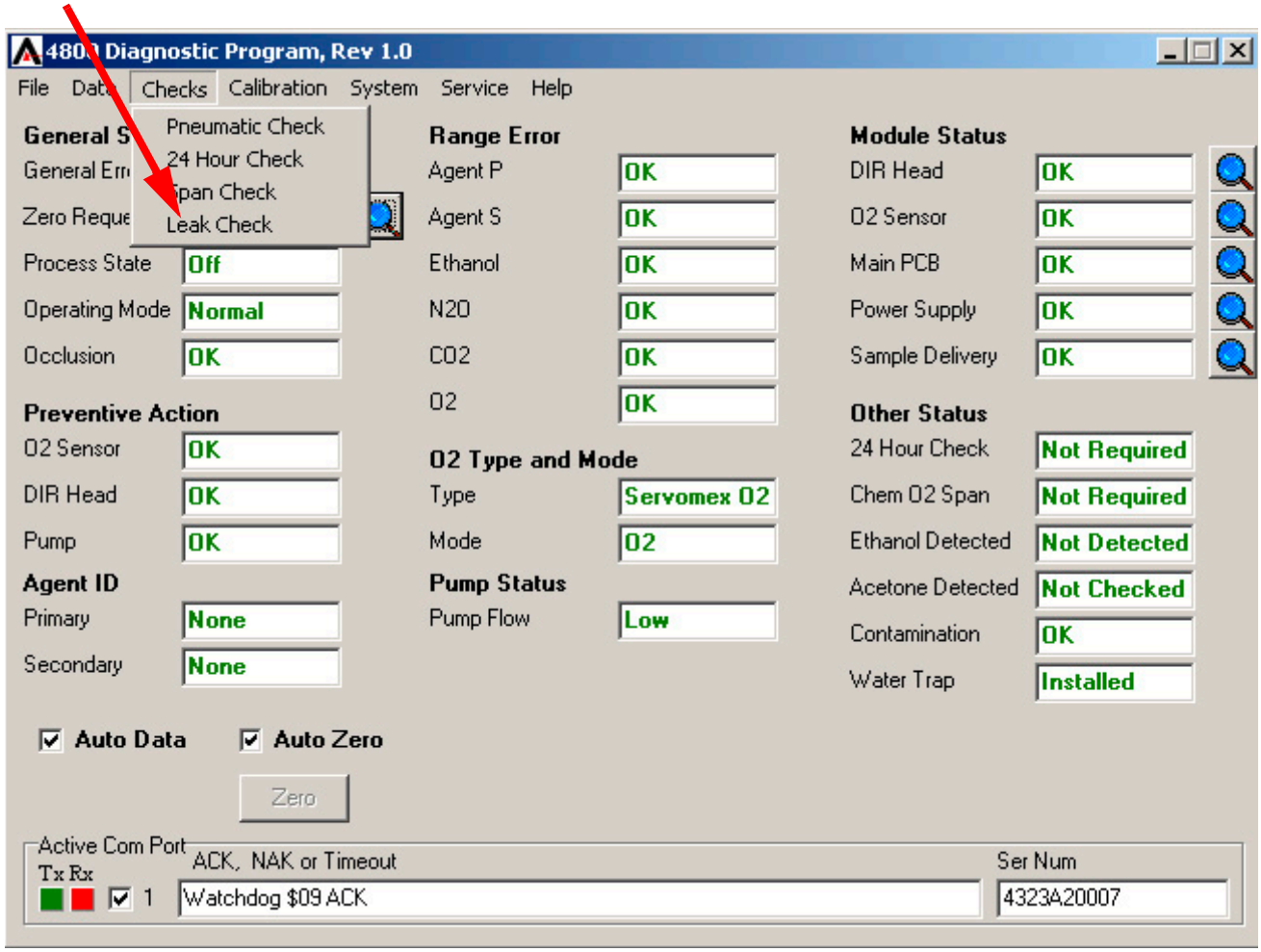


Leak Check

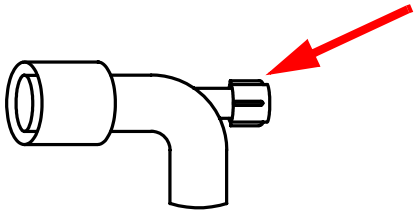
Complete the following steps to do a leak check:

NOTE Do not perform the leak check while a Zero calibration is running.

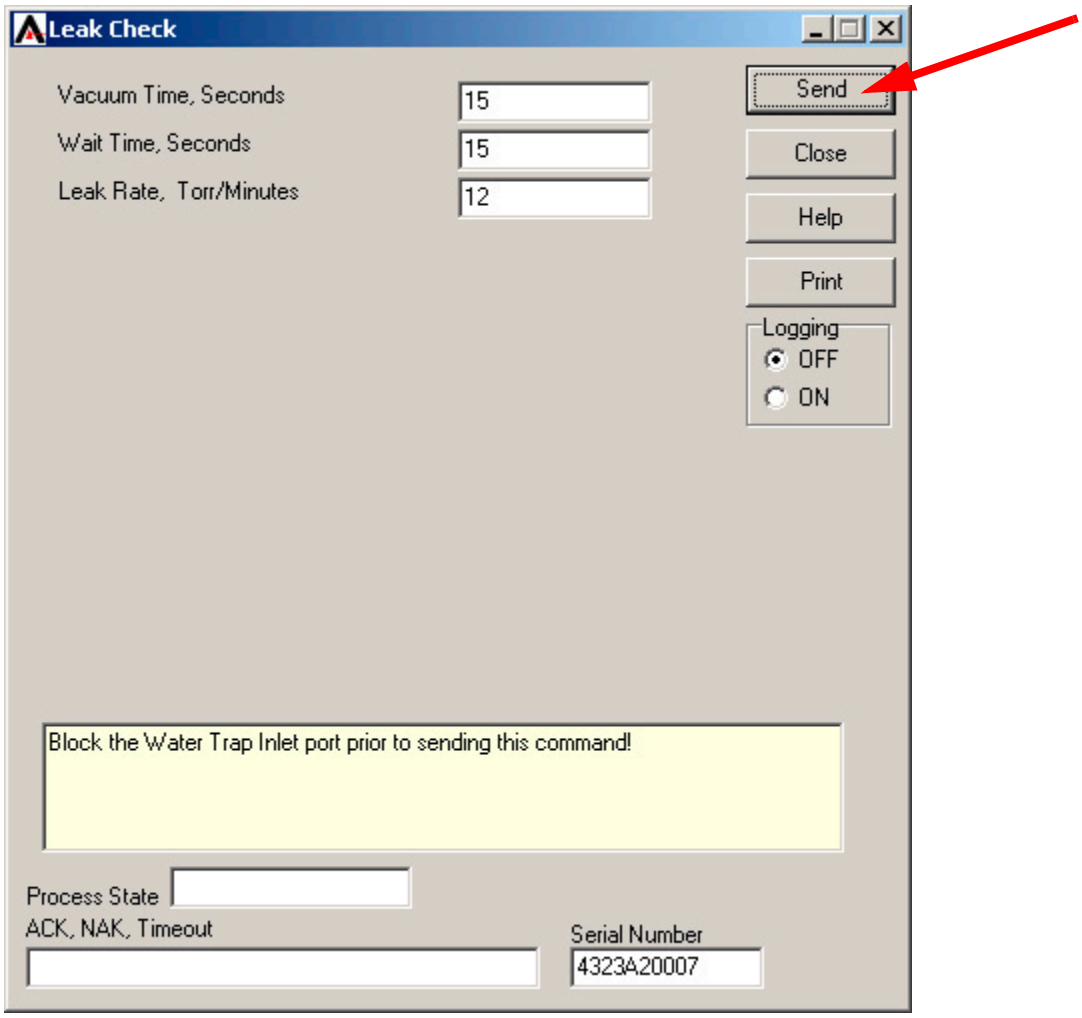
1 Select **Leak Check** from the Checks pull down menu.



2 Block the watertrap inlet using for example the cap of the airway adapter.



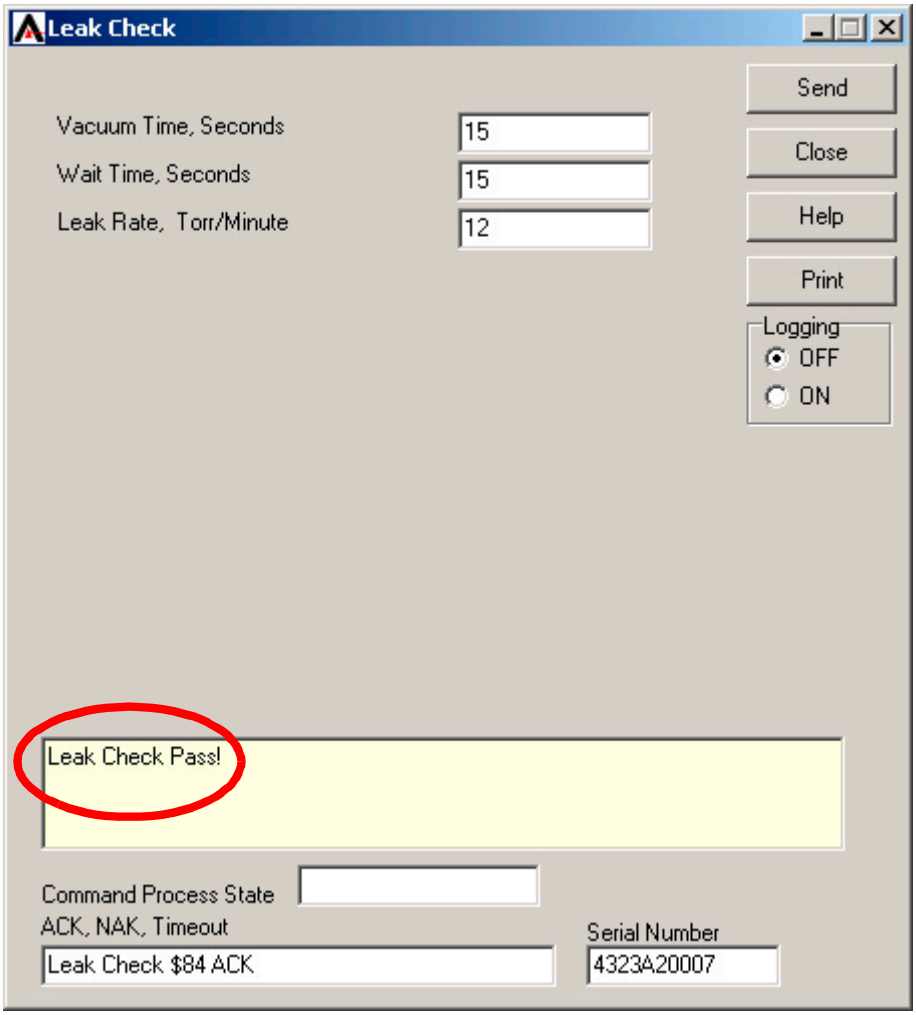
3 Click **Send** in the Leak Check window.



4 While the leak check is running, the **Process State** field will read *In Process*.

5 Wait until the **Process State** field goes blank again, indicating that the check is finished. Then remove the blockage from the watertrap inlet.

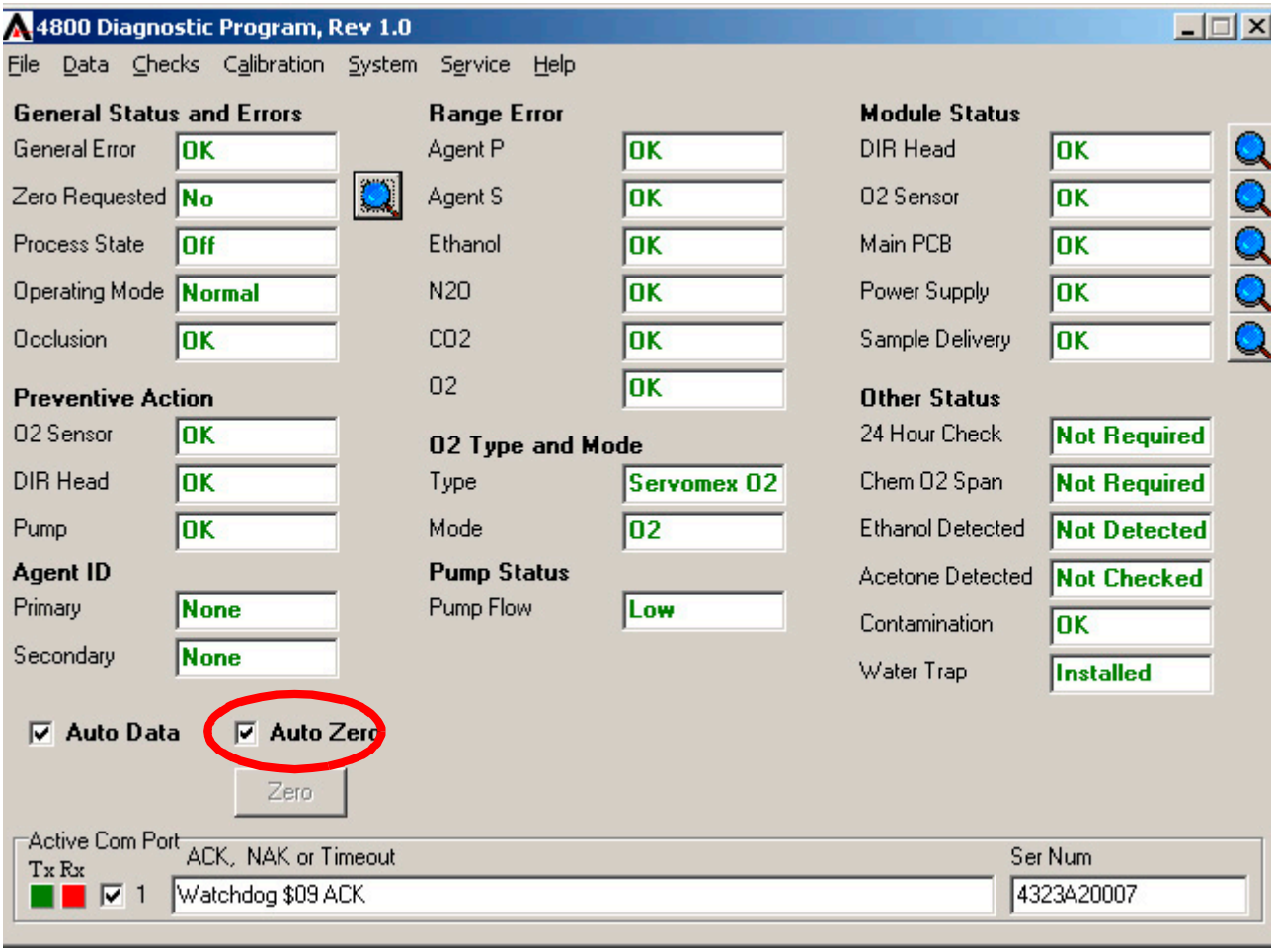
6 Check whether the leak check reports pass or fail. If the leak check fails make sure all internal tubing connections are tight.



Zero Calibration

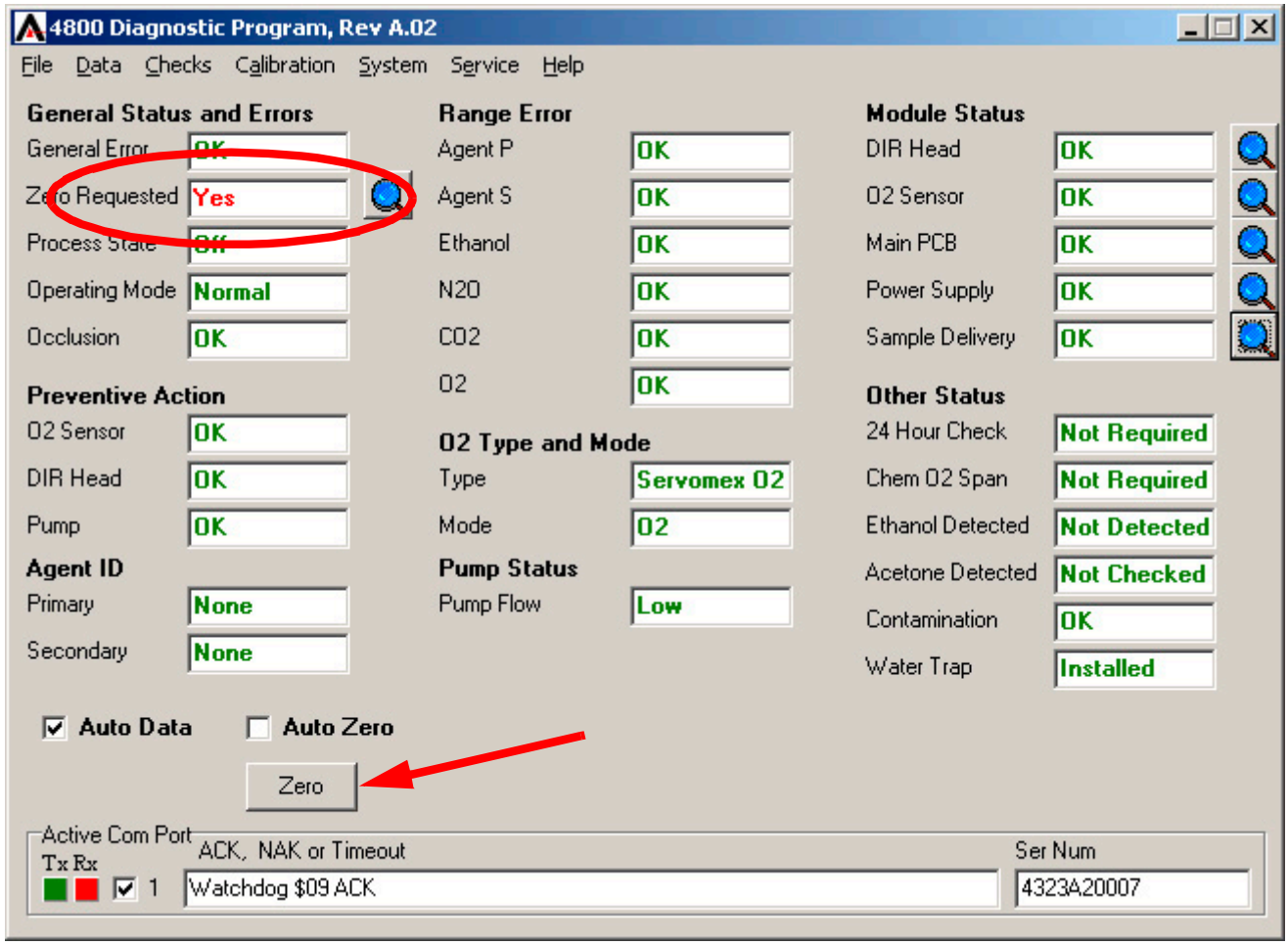
NOTE Only perform a zero calibration with the top cover closed. Light and electro-magnetic interference may affect the measurements. Zero calibration is not possible during warm-up.

A zero calibration will be performed automatically when required if **Auto Zero** is selected in the Service Tool main screen.



If **Auto Zero** is not selected the **Zero Requested** field will read *Yes* everytime a zero calibration is required. To perform a zero calibration manually:

1 Click **Zero** in the Service Tool main screen.



Span Check

NOTE The Philips M1026B Anesthetic Gas Module should run for 2 minutes until the operating mode in the service tool reads *Normal* before continuing with the following calibration procedures. This is to allow the module to reach a stable measurement condition.

Only perform Span checks when the top cover is closed. Light and electro-magnetic interference can affect the measurements.

Before performing a Span check, you ***must*** first:

- perform a Leak Check.
- perform a Zero Calibration.
- Ensure that there is enough gas in the check gas bottle.
- Check tubing assembly.

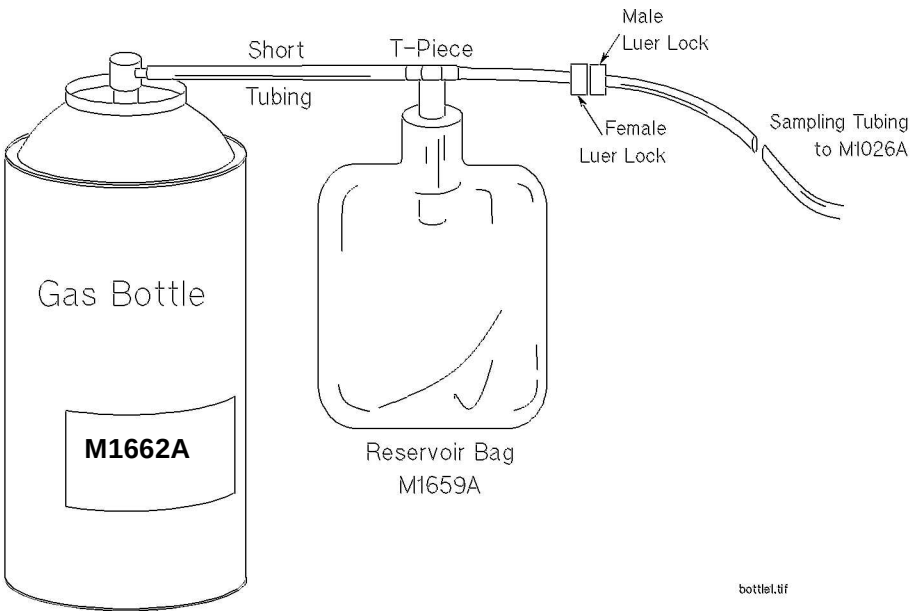
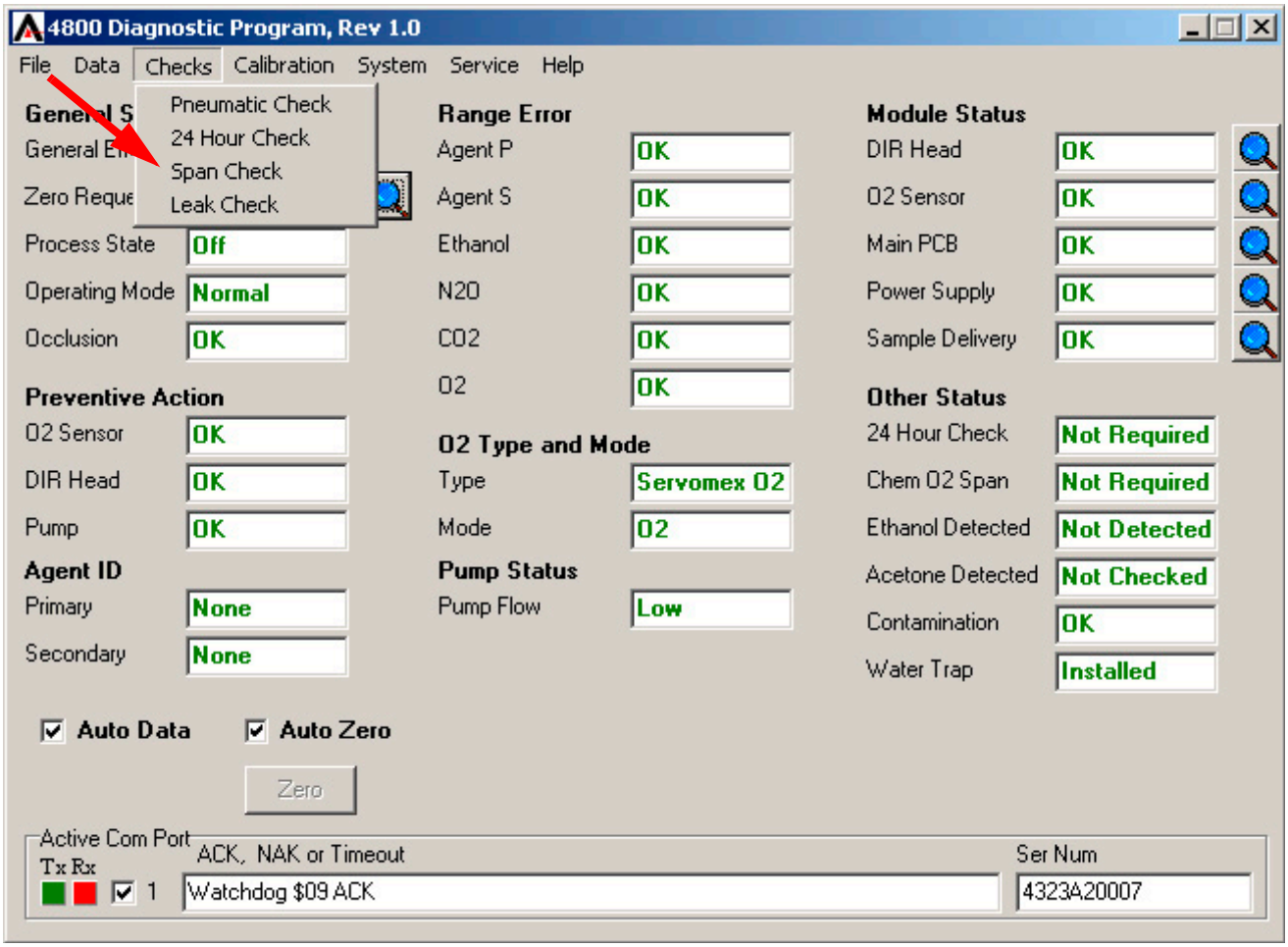


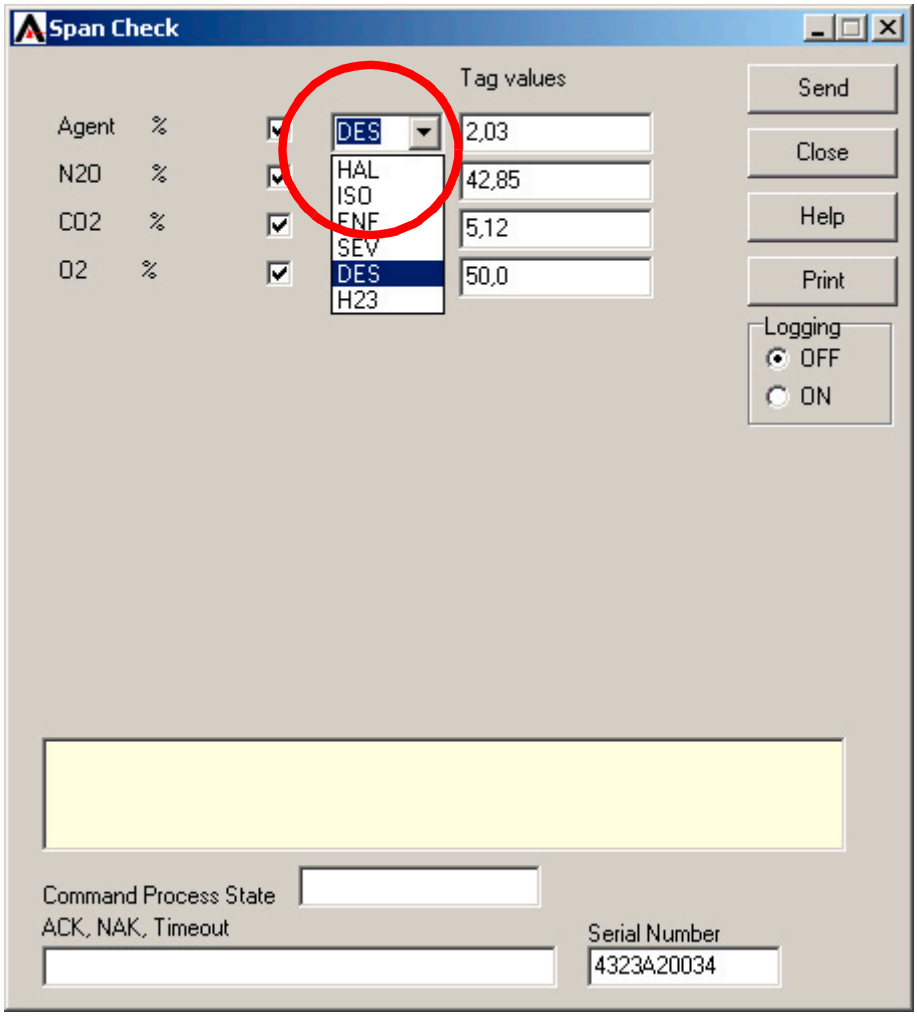
Figure 7 Span Checking Equipment including Gas Canister and Spray Valve

CAUTION Ensure that the room you are working in is well-ventilated, and that the Philips M1026B Anesthetic Gas Module exhaust is properly connected to the gas scavenging system.

1 Select **`Span Check`** in the Checks pull down menu.



2 Select the agent you are checking and enter the corresponding gas values as given on the chck gas bottle.



3 Connect the calibration gas bottle, the reservoir bag and the sample line as shown in Figure 7, "Span Checking Equipment including Gas Canister and Spray Valve".

4 Wait until the **Sample Delivery** field in the **Module Status** section of the service software reads *Error*, indicating taht the reservoir bag is empty. Now wait for another 10 seconds to let the Anesthetic Gas Module completely evacuate the reservoir bag.

5 Now fill the reservoir bag with gas.

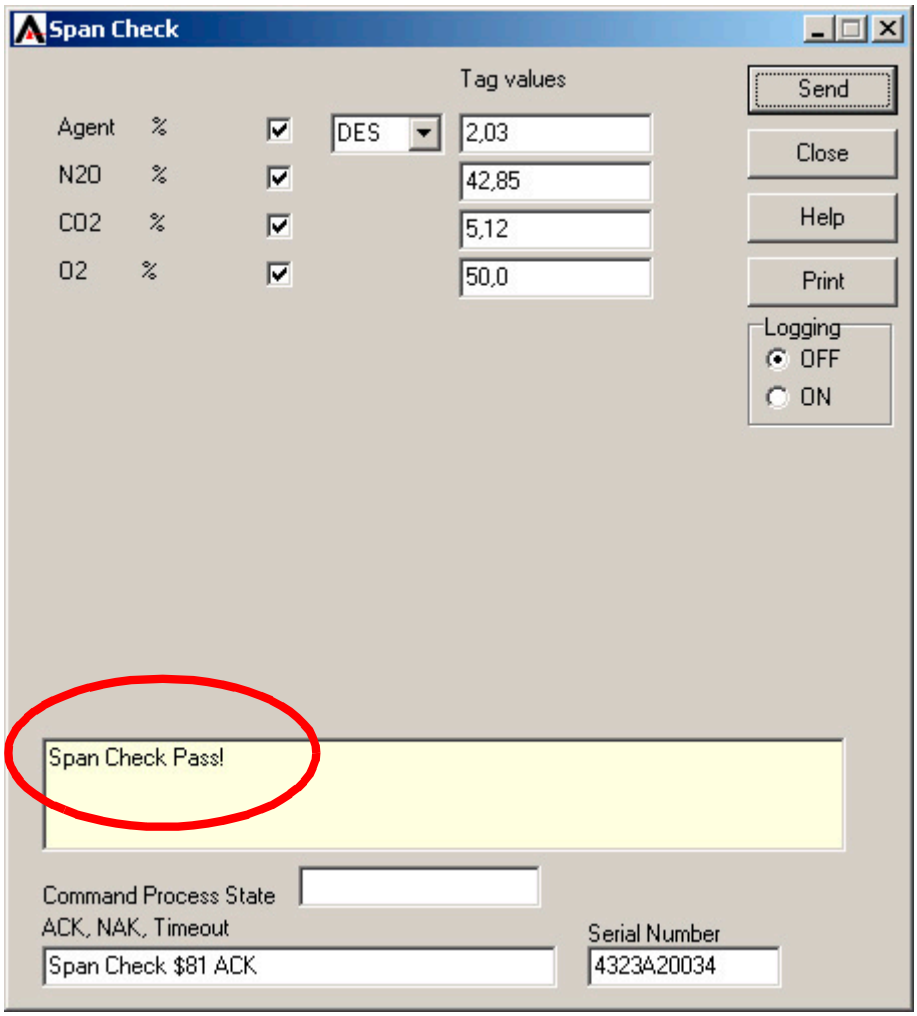
CAUTION Do not pressurize the reservoir bag.

Do not attempt the span check process if there are any visible leaks in the bag or tubing.

Prevent the bag from emtying before the span check procedure is complete.

6 Click Send in the Span Check window.

7 Check whether the check has been passed.



8 If the check has not passed, check for any errors in the module status windows of the service software and proceed to the troubleshooting section of this manual.

Disposal of Empty Gas Cylinder

1 Empty cylinder completely by pushing in the pin of the valve.

2 Once the cylinder is empty, drill a hole in the cylinder

CAUTION Be careful to assure that the cylinder is completely empty before you try to drill the cylinder.

3 Write "Empty" on the cylinder and place it with your scrap metal or, if you do not collect scrap metal for recycling, dispose of the cylinder.

Flowrate Check

1 Before starting a flowrate check, get an ambient pressure reading by:

a. performing a zero calibration

b. performing a pneumatic check to update temperature and pressure data

c. selecting the **Temperature and Pressure Data** from the Data pull down menu and clicking on send.

The **Ambient Pressue (mmHg)** field in that window provides the ambient pressure that should be used for correcting the electronic mass flowmeter reading.

2 Connect a flowmeter to the flow split test fixture.

3 Check the measurement path flowrate at low flow and high flow.

4 If you are using the electronic flowmeter M1026-60144, correct the reading for each step according to the following formula:

$$\text{Actual Flow} = \frac{\text{Flow Reading} \times 760\ \text{mmHg}}{\text{Actual Ambient Air Pressure}}$$

or: in order to get the actual reading for a desired flowrate:

$$\text{Flow Reading} = \text{Desired Flowrate} \times \frac{\text{Actual Ambient Air Pressure}}{760\ \text{mmHg}}$$

	Flowrate in each mode	Tolerance
Low flow	96 ml/min	+/- 5ml/min
High flow	160 ml/min	+/- 8ml/min

If the flowrate is out of tolerance, perform a flow calibration.

Total Flowrate Check

1 Restart the M1026B Anestehtic Gas Module.

2 Connect the Anesthetic Gas Module to the patient monitor.

3 Measure the total flowrate at the watertrap. It should be 150 +/- 15 ml/min. If it is out of tolerance, troubleshoot the pneumatics assembly.

Flow Calibration

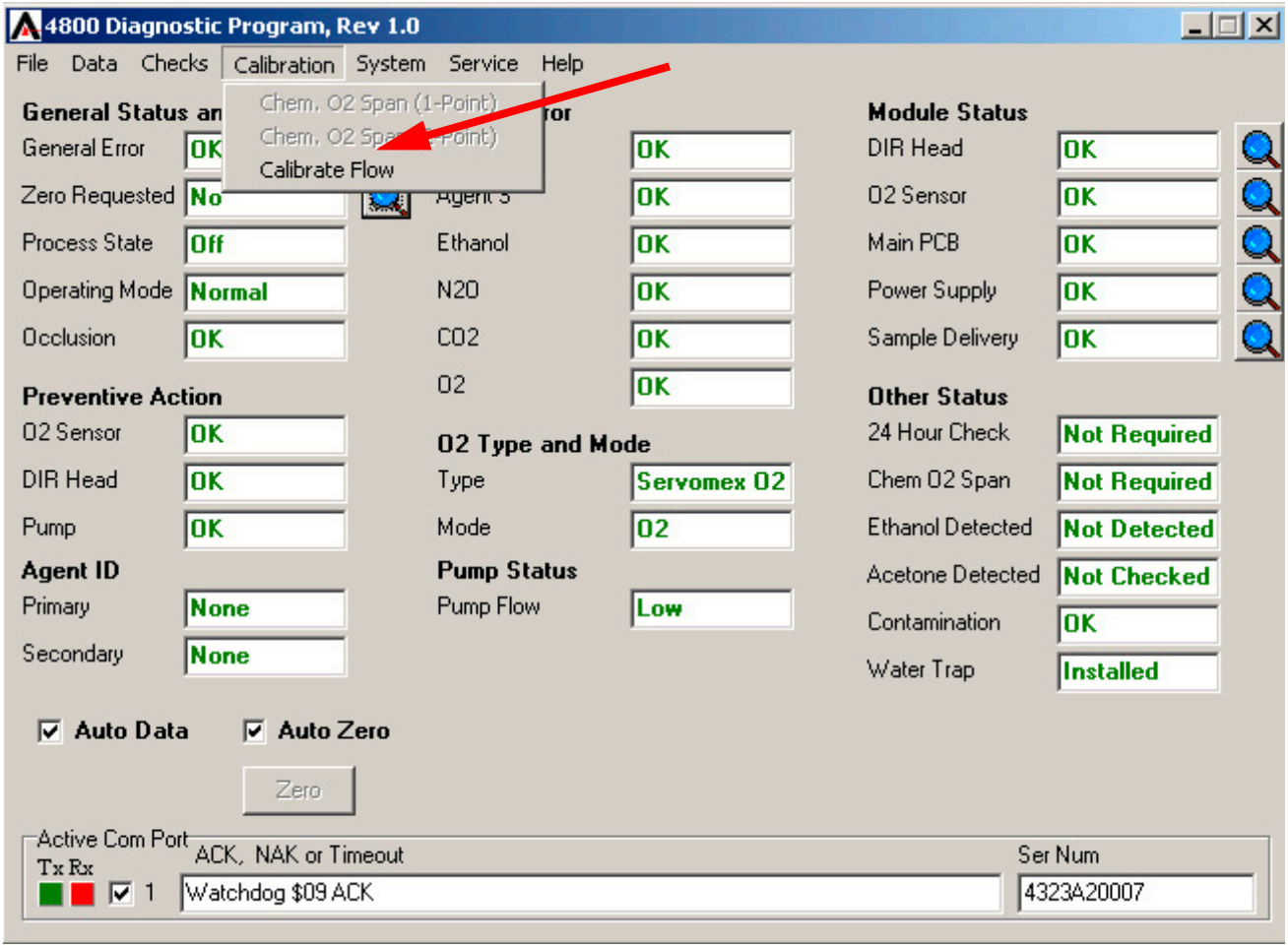
1 Before starting a flow calibration, get an ambient pressure reading by:

a. performing a zero calibration

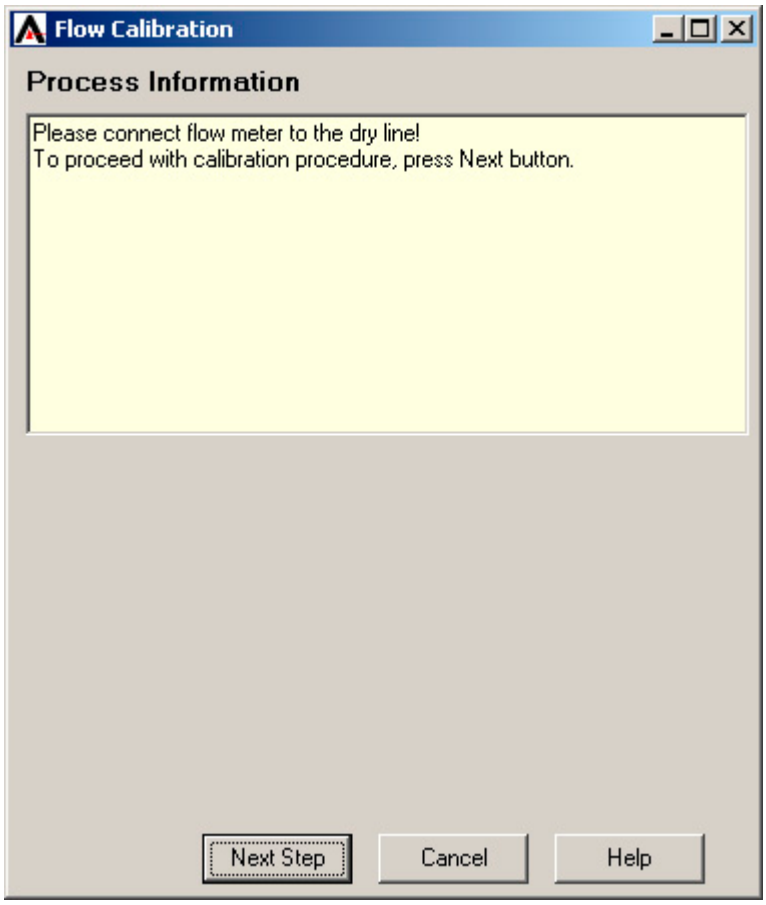
b. selecting the **`Temperature and Pressure Data`** from the Data pull down menu and clicking on send.

The **Ambient Pressue (mmHg)** field in that window provides the ambient pressure that should be used for correcting the electronic mass flowmeter reading.

2 Select **`Calibrate Flow`** from the Calibration pull down menu.



3 Connect the Flowmeter to the dry line of the flow split test fixture and then click **Next Step**.



4 If you are using the electronic flowmeter M1026-60144, correct the reading for each step according to the following formula:

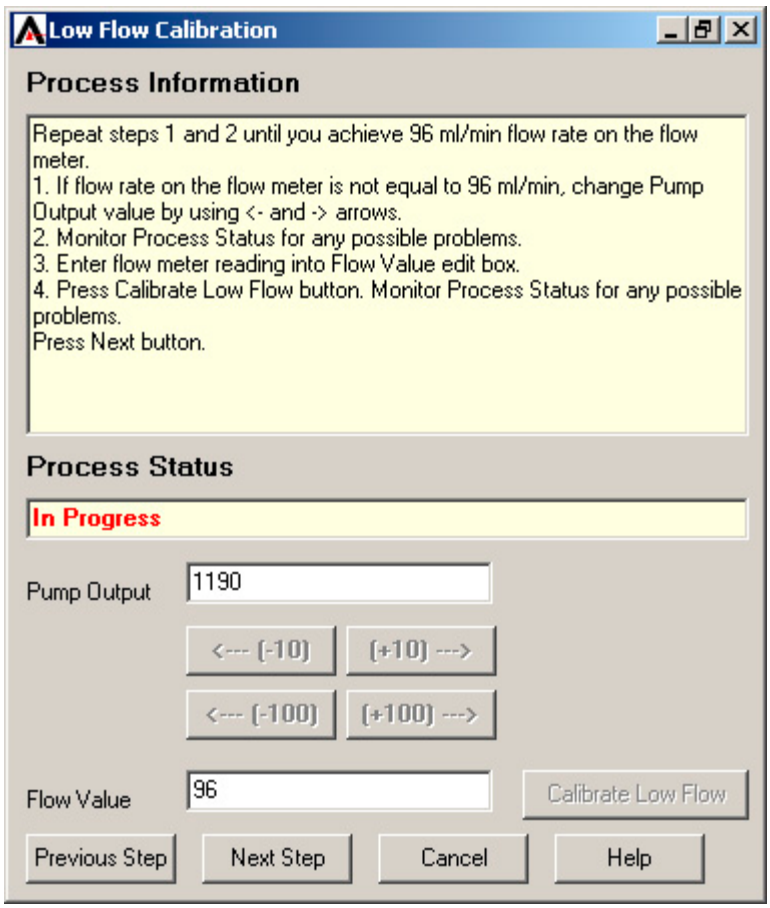
$$\text{Actual Flow} = \frac{\text{Flow Reading} \times 760\ \text{mmHg}}{\text{Actual Ambient Air Pressure}}$$

or: in order to get the actual reading for a desired flowrate:

$$\text{Flow Reading} = \text{Desired Flowrate} \times \frac{\text{Actual Ambient Air Pressure}}{760\ \text{mmHg}}$$

5 Calibrate:
- Low Flow,
- High Flow and
- Purge Flow

always following the instructions on the screen while making sure to correct the reading as described in step 3 above.

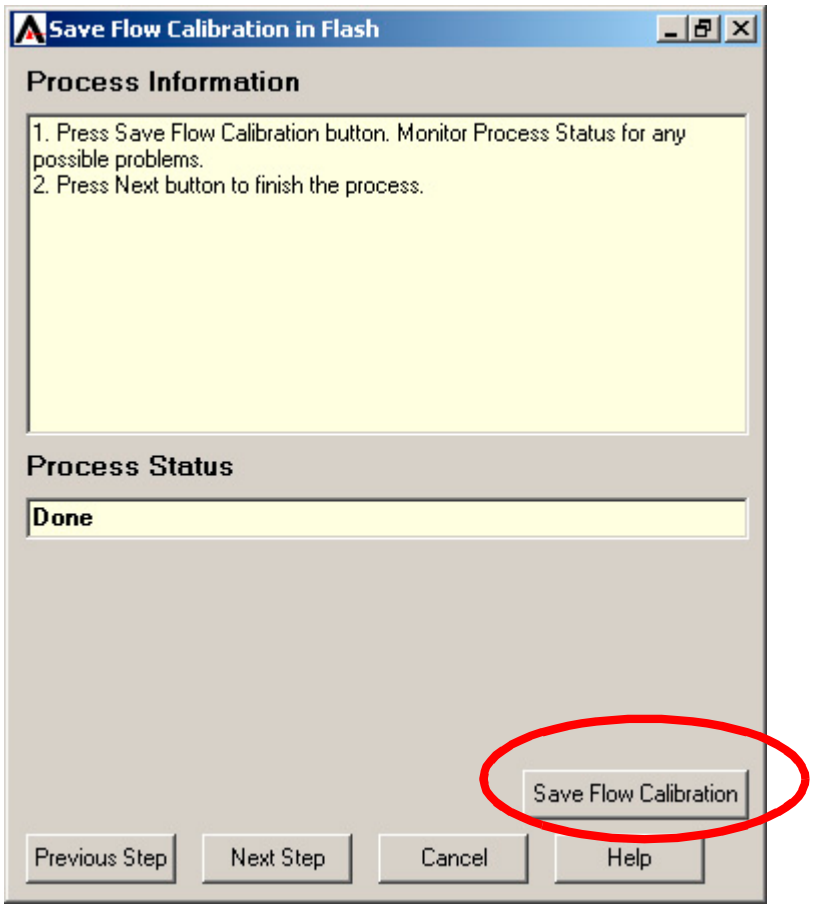


Always click the **`Calibrate Low/High/Purge Flow`** button before proceeding with **`Next Step`** and allow the instrument to stabilize before calibrating on a certain flowrate.

If the desired flowrate cannot be reached exactly, take the actual flow reading and (after coorecting it for ambient air pressure influences if using the M1026-60144) enter this value into the field **Flow Value**.

NOTE During the flow calibration procedure (especially at the purge flowrate) a **Sample delivery** error flag and a yellow correctable error may appear on the main screen of the M1026B Service Software. These should disappear after the calibration procedure is completed.

6 Save the calibration and click **Next Step** to complete the flow calibration process.



4

Maintaining the Anesthetic Gas Module

WARNING Failure to implement a satisfactory maintenance schedule by the individual, hospital or institution responsible for the operation of this equipment may cause equipment failure and possible health hazards.

This chapter describes the **Preventive Maintenance** tasks (PMs) required to keep the Philips M1026B Anesthetic Gas Module in good working order. PMs are performed to a timetable before problems arise as a means to reduce failures.

A test and inspection matrix which explains when and how to perform safety and performance tests is included at the end of the chapter.

All checks that require the instrument to be opened must be made by qualified service personnel.

CAUTION Take precautions when dealing with potentially contaminated parts, such as tubing and other components of the patient circuit. Wear gloves, mask and gown while handling components that come into contact with the patient's exhalant gas or fluids.

Preventive Maintenance (PM) Tasks

Here is a list of the PM tasks required to ensure satisfactory operation of the Philips M1026B Anesthetic Gas Module within its specified limits and how often they must be performed.

- Check the fan filter for occlusions every **6 months**.
- Check the fan in the AGM for proper operation every **6 months**.
- Check the AGM's accuracy at least once every **12 months**, or whenever the validity of the readings is in doubt. Refer to *Checking and Calibrating the Anesthetic Gas Module* for details.
- Replace the parts contained in the PM Kit every **24 months**.
  Check the pump hours during the replacement procedure. If the pump hours exceed 10000 hours, replace the pneumatic assembly.
- Check electrical safety (ground impedance and enclosure leakage current test) at least every **12 months** or every time the device is removed and reinstalled.

Cleaning

Each time the top cover is removed from the AGM for repair or calibration, you should take the opportunity to clean the inside of the module, as the fan may draw debris such as dust and lint into the enclosure.

WARNING Switch off the instrument and disconnect it from the mains power supply. Take standard electrostatic precautions. For example, wrist strap connected to electrical ground.

The user should be encouraged to periodically clean the exterior casing of the AGM. The outside of the gas sample tubing should be cleaned before connecting to the next patient.

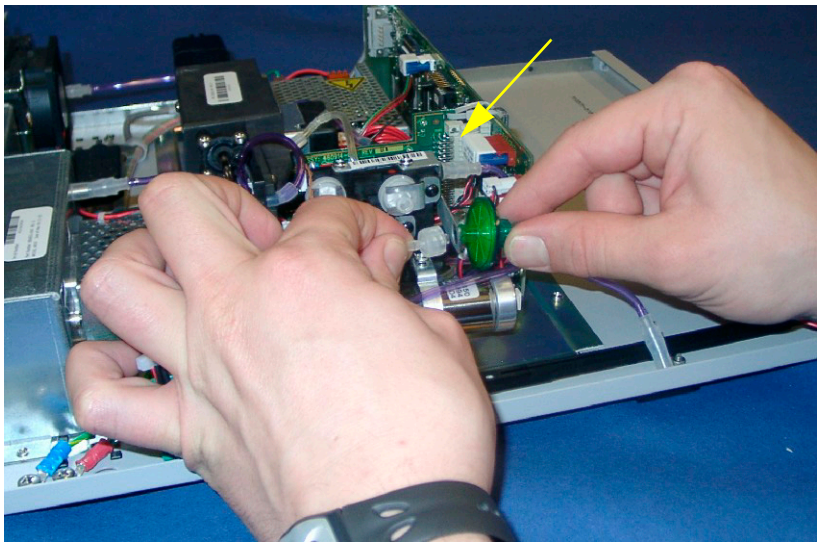
Replace PM Parts

Every **24 months** the PM parts should be replaced for new with the PM kit. The PM kit comprises:

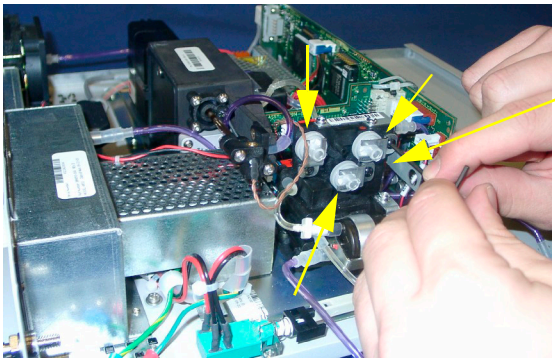
- 4 bacterial filters
- 1 pump outlet filter
- 2 fan filters
- pump tubing kit
- 2 watertrap manifold seals

Replacing the Pump Oulet Filter and the Bacterial Filters

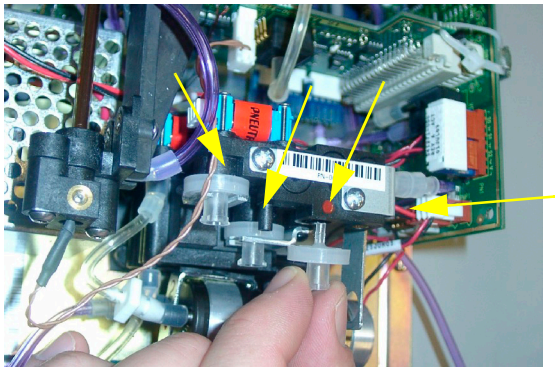
1 Remove the tubing from the green pump outlet filter and replace the filter.



2 Remove the screws and brackets securing the four bacterial filters and replace the filters.

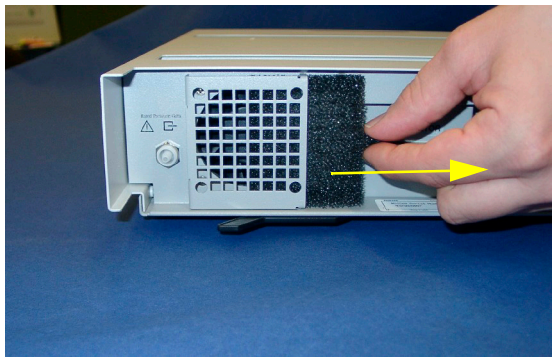


4th filter on the side of the pneumatic assembly



Replacing the Fan Filter

1 Pull out the fan filter to the right from the fan and replace it with a new one.



Replacing the Watertrap Manifold Seals

1 Remove the two screws holding the watertrap manifold on the protector. The screws are accessible from the rear side of the front cover through two holes provided for this purpose.

2 Pull out the two seals from the tubing connectors of the manifold using pointed tweezers; slide one side of the tweezers between the seal and the connector, then grasp and pull.

3 Take a new seal in the tweezers and press it onto the fitting in the tubing connector. Push down on the seal using the handle of the tweezers (or another blunt instrument), taking care not to damage the seal, until it sits properly. Repeat with the second seal.

4 Screw the watertrap manifold onto the protector through the holes in the front cover.

Test and Inspection Matrix

The Test and Inspection Matrix describes:

- which tests need to be performed
- the expected test results
- what should be written by Philips service personnel on the Philips Installation Report or Customer Service Order (CSO).

The second section *When to Perform Test Blocks* describes when the tests should be performed.

These tables should be followed for all installations and repairs.

NOTE The test procedures outlined for this test block are to be used only for verifying safe installation or service of the product in question. The setups for these tests and the acceptable ranges or values are derived from local and international standards but may not be equivalent. These are not a substitute for local safety testing where it is required for an installation or service event.

Test Block Name	Test or Inspection to be performed	Expected Test Result	What to Record on Service Record
Visual	Check for any mechanical damage and all external leads and accessories. Is the device free of damage and are all accessories properly set up?	Expected answer is "yes". If so, visual test is passed.	V: P or V: F where P=Pass and F=Fail
Power On	Switch on the module. A built-in selftest and communication test are running for two minutes after "Power On". The green setup LED near the power button indicates by flashing if one of the tests failed. When tests are successfully completed after 2 minutes the LED is off and the AGM will enter normal operating mode Does AGM boot up successfully without displaying any error or malfunction messages?	Expected answer is "yes". If so, PowerOn test is passed.	PO: P or PO: F where P=Pass and F=Fail
Leak Check	Perform Leak Check	Leak Check passed	PL: P or PL: F where P=Pass and F=Fail
Performance Diagnostic Check	Does the status of each subassembly display as "OK" in Service Software?	If so, Error/Diagnostic check is passed.	PD:F where P=Pass and F=Fail

Test Block Name	Test or Inspection to be performed	Expected Test Result	What to Record on Service Record
Performance Zero Calibration Check	Does the status of each channel display as "OK" in the Service Software after a zero calibration has been performed?	Expected answer is "yes". If so, zero calibration check is passed.	PZC:P or PZC:F where P=Pass and F=Fail
Performance Span Check	Perform the Span Check.	Span Check passed	PSH:P or PSH:F where P=Pass and F=Fail
Performance Normal Operation Check	Enter Monitoring mode and check that all AGM related waves and numerics are present and correspond to the user's configuration. Are all AGM waves and numerics present according to the user's configuration?	Expected answer is "yes". If so, performance normal operation check is passed.	PNO: P or PNO: F where P=Pass and F=Fail
Performance Fan Check	Check that the cooling fan runs smoothly.	Expected answer is "yes".	PFA: P or PFA: F where P=Pass and F=Fail
Safety	Step 1 Protective Earth. See Safety Test section for details / S (2). Step 2 Enclosure Leakage Current - Normal Condition. See Safety Test section for details / S (4). Step 3 Enclosure Leakage Current - S.F.C. Open Supply. See Safety Test section for details / S (5). Step 4 Enclosure Leakage Current - S.F.C. Open Earth. See Safety Test section for details / S (6).	With mains cable: Maximum impedance = x1 (<= 100 mOhms) Maximum leakage current = x2 (<= 100 uA) Maximum leakage current = x3 (<=500uA) (<= 300 uA, for US and/or UL devices) Maximum leakage current = x4 (<=500uA) (<= 300 uA, for US and/or UL devices)	S:P/x1/x2/x3/x4 or S:F/x1/x2/x3/x4 where P=Pass and F=Fail

When to Perform Test Blocks

Service Event (When performing.....	Test Block(s) Required ..... Complete these tests)
Installation	Visual, Power On Leak Check, Diagnostic Check, Zero Calibration Check, Span Check and Normal Operation Check
Repair/Parts replacement	Leak Check, Diagnostic Check, Zero Calibration Check, Span Check and Normal Operation Check, Safety (whenever the topcover was opened)
Preventive Maintenance	Parts Replacement Fan Check, Leak Check, Diagnostic Check, Zero Calibration Check, Span Check and Normal Operation Check, Safety

Safety Tests

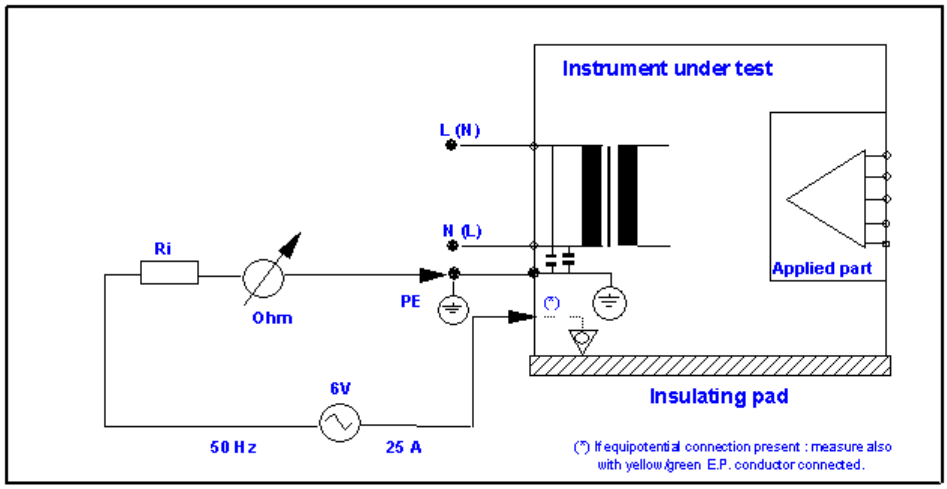
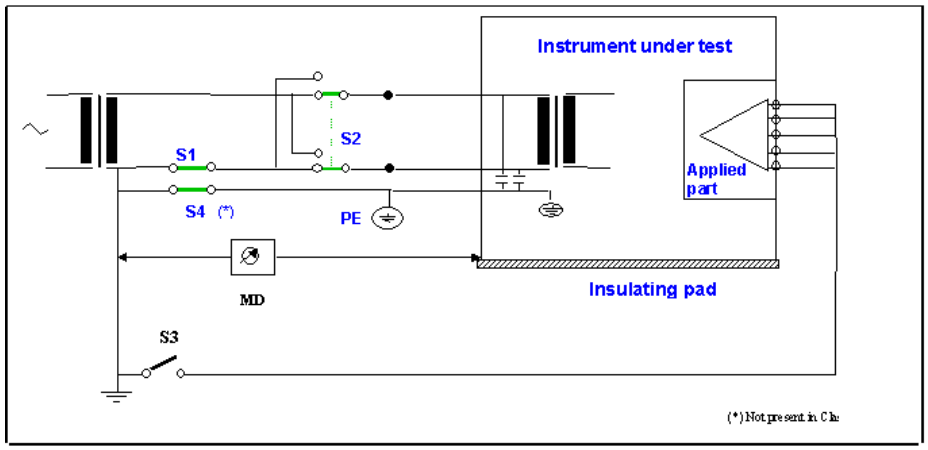
The test procedures outlined in this appendix are to be used **only** for verifying safe installation or service of the product in question.

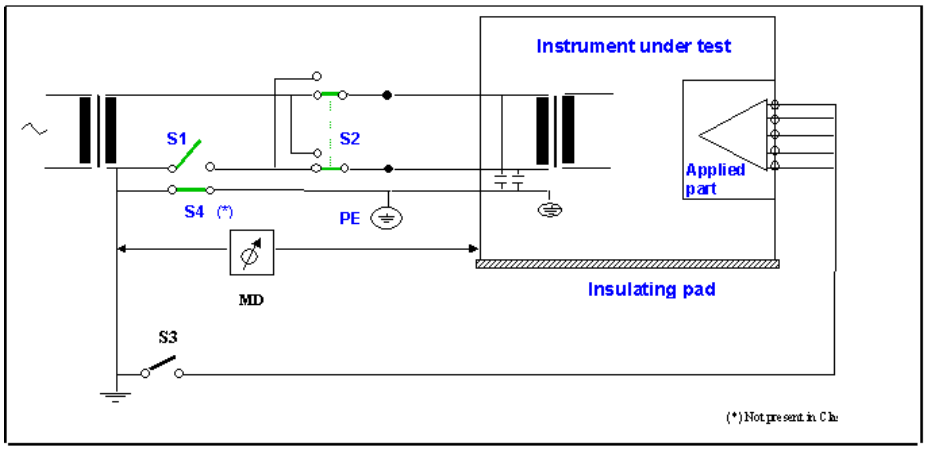
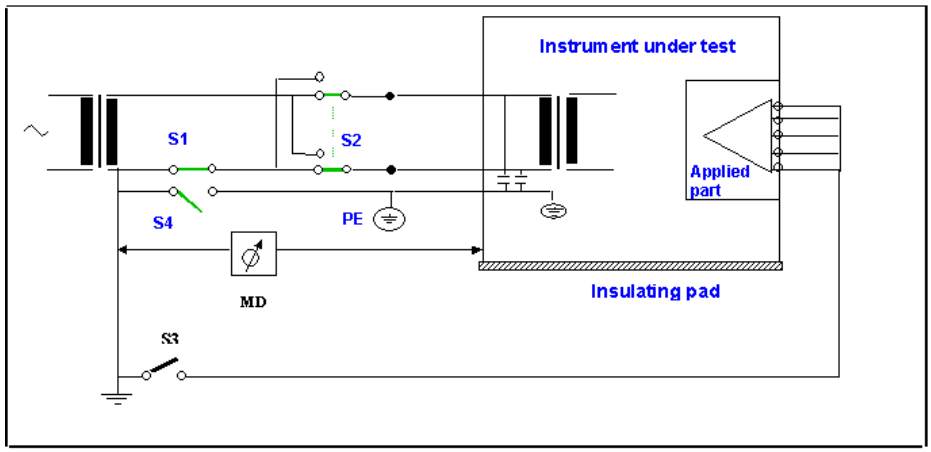
The setups used for these tests and the acceptable ranges of values are derived from local and international standards but may not be equivalent.

These tests are **not a substitute for local safety testing** where it is required for an installation or a service event.

If using the Metron Safety tester use your local regulation to perform the test, *for example* in Europe IEC60601-1/IEC60601-1-1 and in the US UL2601-1. The Metron Report should print results with the names listed below, along with other data.

Safety checks at installation refer to safety aspects directly related to the installaton and setup activities and not to intrinsic safety features that have already been checked during final acceptance testing at the factory.

Test Block name	Test or Inspection to perform
S(2) Protective Earth	
	Measures impedance of Protective Earth (PE) terminal to all exposed metal parts of Instrument under Test (IUT), which are for safety reasons connected to the Protective Earth (PE). Includes normally the wiring in the mains cable (max. 100 mOhm). Test current 25 Amps applied for 5 seconds to 10 seconds. The recommendation is to flex the main cable during the test in order to identify potential **bad** contact or damage of the earth wire. *Safety test according IEC 60601-1 (Clause 18)* Report largest value.
S(4) Test ENCL.1: Enclosure Leakage Current - NC (normal condition)	
	Applicable to Class 1 & 2 equipment, type B, BF & CF Applied Parts.Measures leakage current of exposed metal parts of UIT; normal and reversed polarity using S2. For type BF & CF Applied Parts measures with AP/GND switch S3 open and closed. *Safety test according to IEC 60601-1 (Clause 19.4g)* Report largest value.

Test Block name	Test or Inspection to perform
S(5) Enclosure Leakage Current – Single Fault Condition Open Supply	
	Applicable to Class 1 & 2 equipment, type B, BF & CF Applied Parts.Measures leakage current of exposed metal parts of IUT with one supply lead interrupted (S1=open); normal and & reversed polarity using S2. For type BF a& CF Applied Parts measures with AP/ GND switch S3 open and closed. *Safety test according to IEC 60601-1 (Clause 19.4g)*Report largest value.
S(6) Enclosure Leakage Current - Single Fault Condition Open Earth (Ground)	
	Applicable to Class 1 equipment, type B, BF, & CF Applied Parts. Measures leakage current of exposed metal parts of UIT with Protective Earth open-circuit (S4=open); normal & reversed polarity using S2. For type BF & CF Applied Parts measures with with AP/GND switch S3 open and closed. *Safety test according to IEC 60601-1 (Clause 19.4g)* Report largest value.

5

Troubleshooting the Anesthetic Gas Module

This chapter provides a recommended procedure for locating and identifying faults on the Philips M1026B Anesthetic Gas Module.

It details how to identify hardware problems and how to proceed when measurement related INOPs occur.

It details how to proceed when errors are flagged for:

- Failed calibration checks and procedures
- Failed diagnostic checks.

Equipment needed for troubleshooting:

- Flowmeter
- Flow Split Test Kit
- Calibration equipment
- PC/Laptop running the M1026B service software
- RS232 cable to establish the connection between M1026B and Laptop

INOPs

Check out the possible problems in the order given in the following table.

INOP (IntelliVue)	INOP (CMS/V24/V26)	Possible Problem/Cause	Corrective action
AGM NOT AVAIL.	GAS AN. NOT AVAIL.	AGM not switched on.	Switch on AGM
		AGM not properly connected.	Check physical connections. If problem persists, connect service software and check for possible errors
AGM EQUIP MALF:	GAS AN. EQUIP MALF	Either AGM - monitor connection problem, serious problem with a subassembly or Main PC Board problem.	Check RS232 connection, RS232 cable and MIB board of monitor. If ok, connect M1026B Service Software and check for module status flags. Then proceed to Troubleshooting Table.
AGM SELFTEST	GAS AN: SELFTEST	The AGM selftest is running	Wait until this INOP disappears to start monitoring. If the INOP does not disappear after 2 minutes, connect M1026B Service Software and check for module status flags. Then proceed to Troubleshooting Table.
AGM OCCLUSION	GAS AN. OCCLUSION	External occlusion (inlet or exhaust accessories).	Disconnect all external tubing/filters and check whether occlusion disappears.
		Internal occlusion	Troubleshoot internal occlusion and remove it
		Weak/defective pump	Replace pneumatic assembly
		Leakage between pump and flow restrictor	Perform leak check. If it fails, check all internal tubings and connections.
		Flow transducer incorrectly connected to flow restrictor	Check that the transducer ports A and B on the Main PC board are connected to the correct side of the flow restrictor.
AGM UNABLE TO MEAS:	GAS AN. UNABLE TO MEAS.		No action necessary. This situation usually corrects itself after a few seconds. If not, restart the AGM. If the problem persists, connect M1026B Service Software and check for module status flags. Then proceed to Troubleshooting Table.
AGMZERO RUNNING	GAS. AN. ZERO RUNNG	Autozero in progress.	Wait until Autozero is completed to continue monitoring.

INOP (IntelliVue)	INOP (CMS/V24/V26)	Possible Problem/Cause	Corrective action
AGM ZERO FAILED	GA ZERO FAILED	Purge Flow out of tolerance.	Adjust purge flow and calibrate flow. Repeat zero calibration.
		No flow calibration after pneumatic assembly replacement.	Perform flow calibration
		Occlusion during zero calibration.	Remove occlusion.
		Solenoid(s) defective.	Replace pneumatic assembly.
		Measured ambient pressure does not match with configured altitude in monitor Service Mode (tolerance is +/- 60 mmHg).	Verify correct altitude setting / pressure Cal value. If necessary, adjust the altitude setting in service mode..
		DIR measurement head problem.	Connect M1026B Service Software and check for module status flags. Then proceed to Troubleshooting Table.
AWRR OVERRANGE	AWRR OVERRANGE	The measured respiration rate is higher than the maximum measureable range.	
O_2 ZERO FAILED	O_2 ZERO FAILED	O_2 new zero constants out of range.	Connect M1026B Service Software and check for module status flags. Then proceed to Troubleshooting Table.
O_2 EQUIP MALF	O_2 EQUIP MALF	O_2 is built in, but set to digital 45%.	Connect M1026B Service Software and check for module status flags. Then proceed to Troubleshooting Table.
AGM ACCURACY?	GAS AN ACCURACY ?	Flow rate error.	Check flow (purge and normal), adjust and calibrate if necessary.
		Partial occlusion.	Troubleshoot for occlusion.
		DIR head problem.	Troubleshoot DIR head and replace it if necessary. If it lasts only for a few seconds and clears itself, NO ACTION REQUIRED
O_2 UNABLE TO MEASURE	O_2 UNABLE TO MEASURE	Flow rate error.	Check flow (purge and normal), and calibrate if necessary
		O_2 data not valid.	Connect M1026B Service Software and check for module status flags. Then proceed to Troubleshooting Table.
CO_2 UNABLE TO MEASURE	CO_2 UNABLE TO MEASURE	CO_2 data not valid.	Connect M1026B Service Software and check for module status flags. Then proceed to Troubleshooting Table.

INOP (IntelliVue)	INOP (CMS/V24/V26)	Possible Problem/Cause	Corrective action
AGT UNABLE TO MEASURE	AGT UNABLE TO MEASURE	Agent data not valid.	Connect M1026B Service Software and check for module status flags. Then proceed to Troubleshooting Table.
N_2O UNABLE TO MEASURE	N_2O UNABLE TO MEASURE	N2O data not valid.	Connect M1026B Service Software and check for module status flags. Then proceed to Troubleshooting Table.
CHECK AGENT	CHECK AGENT	The agent selected for monitoring does not match the agent detected by the gas analyzer.	Check that the correct agent is selected.
<AGT> UNABLE TO MEAS.	<AGT> UNABLE TO MEAS.	The gas analyzer currently cannot measure the agent shown.	If this INOP persists, connect M1026B Service Software and check for module status flags. Then proceed to Troubleshooting Table.
GAS CONTAMINANT	GAS CONTAMINANT	A gas contaminant has been detected	Test with room air. if INOP persists, connect M1026B Service Software and check for module status flags. Then proceed to Troubleshooting Table.
AGENT MIXTURE	AGENT MIXTURE	An agent mixture has been detected.	Test with room air. if INOP persists, connect M1026B Service Software and check for module status flags. Then proceed to Troubleshooting Table.
AGT CHANGE SCALE	AGT REDUCE SIZE	The agent data cannot be displayed correctly on the monitor, because the configured scale does not match.	Change the scale configured in your monitor.

Troubleshooting

If you have to troubleshoot the M1026B do the following:

1 With the M1026B Service Software running, power up the instrument, wait for Normal mode. The bench will automatically do a self-test and attempt a zero.
If you see any problem in this state, proceed to the troubleshooting table

2 Perform the **pneumatic check**

3 Perform the **leak check**
if one of these two chceks did not pass, proceed to the troubleshooting table

4 View the Temperature and Pressure data.
Absolute Pressure should be significantly lower (>7mmHg) than **Ambient Pressure** (with pump on)
Differential Pressure should be greater than zero with the pump on (this value will vary from one bench to another)

Troubleshooting Table:

Symptom	Possible cause	Corrective Action
- Leak Check failure - Pneumatic Check Failure - Sample Delivery Error - Absolute pressure not significantly lower (> 7 mmHg) than ambient pressure - Differential pressure not greater then zero	Tubing problem	- is all tubing in good condition? Check for cracks and pinched tubing. - are all tubing connections secure? - if you have just serviced the bench, check to make sure the tubing is connected to the proper locations. It's easy to get some of these reversed if you are not careful.
	Solenoid problem	- are all solenoid cables in good condition? - are all solenoid cables securely connected? - if you have just serviced the bench, assure that the solenoid cables are in their proper locations - turn the pump off, then one at a time turn each solenoid on then off. Can you hear the solenoid click?
	Pump problem	- is the pump cable connected and in good condition? - run the pump at different speeds. Can you hear the pump running?
	None of the above helped	Replace the pneumatic assembly ot order exchange unit. NOTE: If in warranty, always order M1026B exchange unit.
DIR Head error (particularly MISCE-5 IR Scan Data Error)	Connection Problem	- make sure the head PCB is securely connected to the Main PCB - check all head cables, are they secure?
	None of the above helped.	Order M1026B exchange unit
O2 error	Connection problem	- check the O2 head connection to the main PCB
	The above did not help	Replace the O2 assembly or order M1026B exchange unit. NOTE: If in warranty always order M1026B exchange unit.

Main PCB error	Power supply problem	Check in the Power Main PCB details window if **ASERV2-5, ADC +12 Volt Range** or **ASERV2-4, +12 Volt Range** are showing a problem. If this is the case, troubleshoot the Power Supply first.
	The above did not help	Replace the Main PCB or order M1026B exchange unit. NOTE: If in warranty always order M1026B exchange unit.
Power Supply error	Power supply is failing	Replace the Power Supply or order M1026B exchange unit. NOTE: If in warranty always order M1026B exchange unit.

6

Repairing the Anesthetic Gas Module

Introduction

This section contains detailed removal and replacement procedures for all field-replaceable units in the Philips M1026B Anesthetic Gas Module.

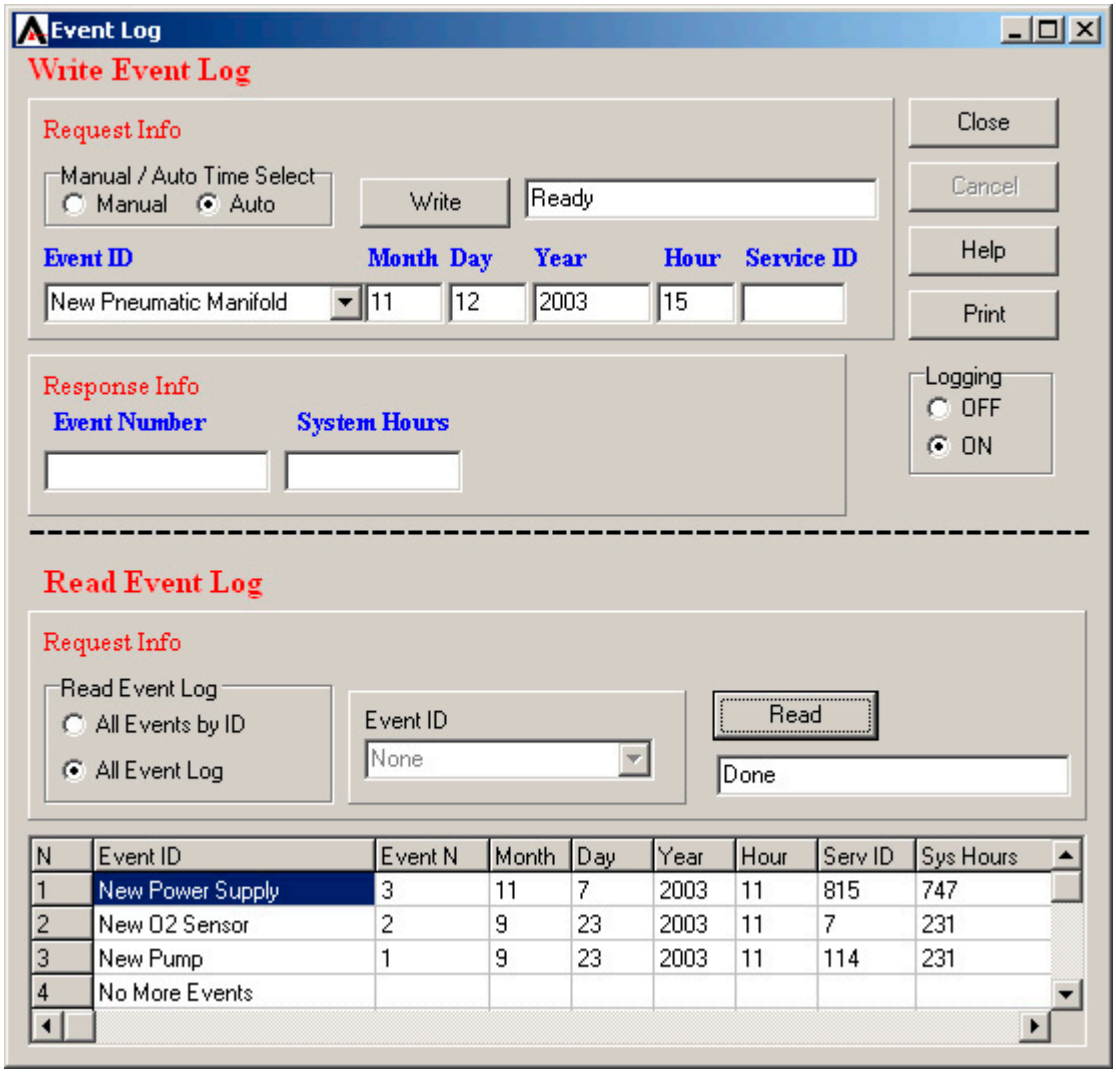
CAUTION Use caution when handling tubing and other components of the patient circuit. Wear gloves, mask and gown while handling components that come into contact with the patient's exhalant gas or fluids.

Before you can remove any of these field replaceable units, you first need to remove the top cover of the Anesthetic Gas Module. The procedure for this is described in *Removing the Top Cover* below.

WARNING Switch off the instrument and disconnect it from the mains power supply. Take standard electrostatic precautions. For example, a wrist strap connected to electrical ground.

Event Log

Whenever a power supply, a pneumatic assembly or an O_2 cell are replaced, record this procedure in the event log of the M1026B Service Software.



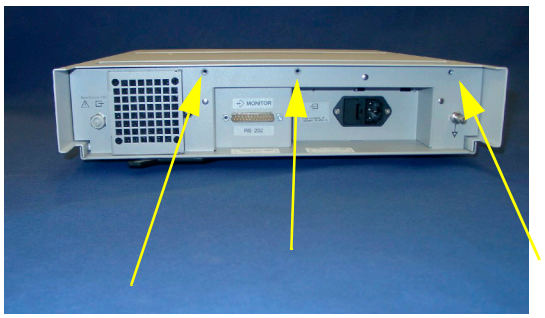
NOTE You need to enter a freely selectable Service ID with every log entry.

Removing the Top Cover

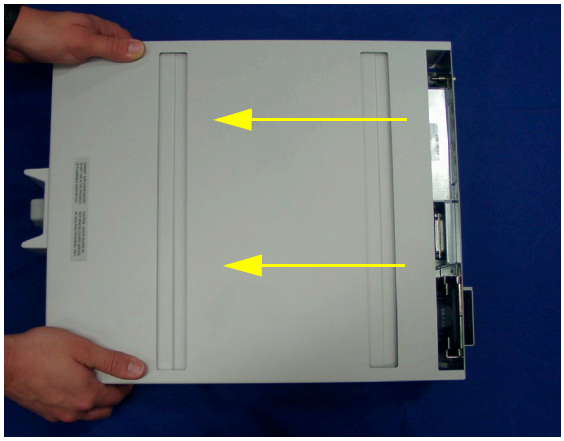
1 Make sure that the module is switched off and isolated from the mains power supply.

2 Remove the watertrap from the front of the cover.

3 Using a cross-tipped screwdriver, remove the 7 screws securing the top cover to the body. These screws are located at the rear of the module and on the sides.

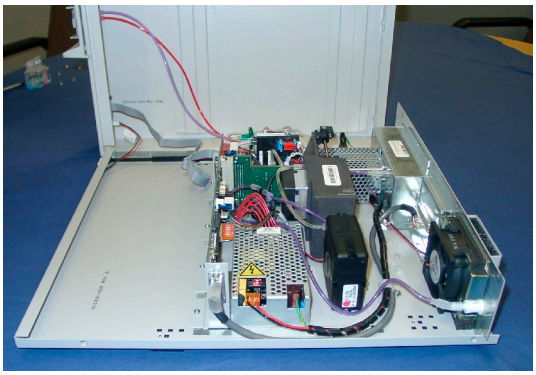


4 Slide the top cover forward approximately 4cm.

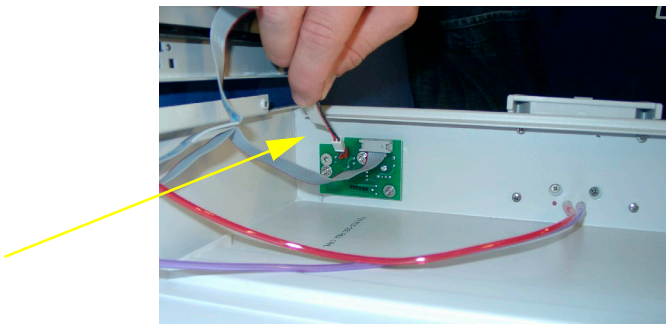


NOTE At this stage, the top cover is still connected to the main PC board by a flat cable and to the Power On LED with a cable and the internal gas tubing.

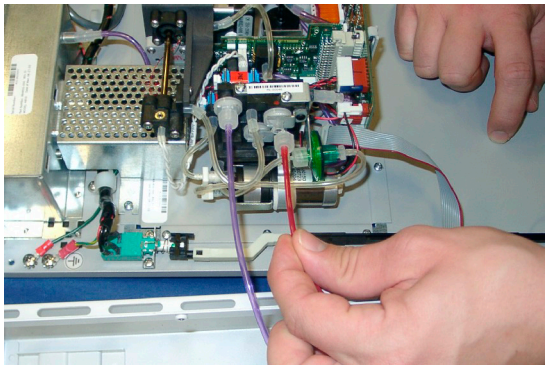
5 Carefully lift the top cover until the flat cable connector leading to the main PC board, the LED connector and the internal tubing are accessible.



6 Remove the LED connector from the front panel PC board inside the top cover.

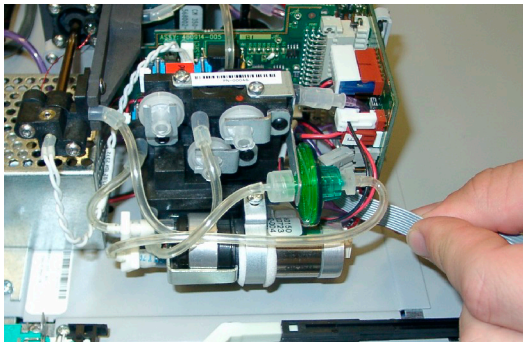


7 Remove the internal tubing from the pneumatic manifold.



NOTE When reconnecting the red tubing , connect it where the red dot is on the pneumatic assembly

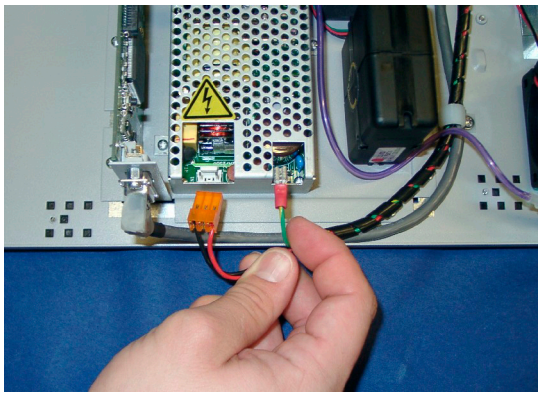
8 Remove the flat cable connector from the main PC board.



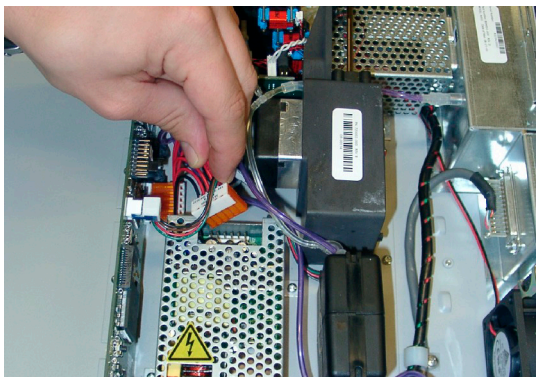
9 Remove the top cover from the module.

Replacing the Power Supply

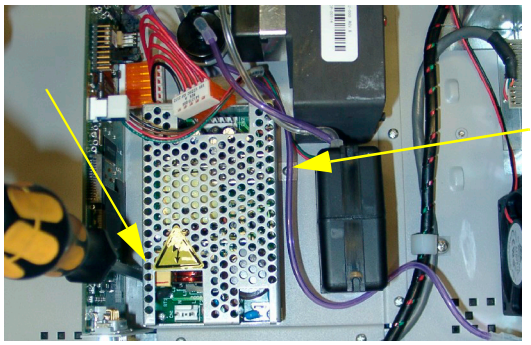
1 Remove the mains and the ground connectors from the power supply.



2 Remove the connector to the main PC board.

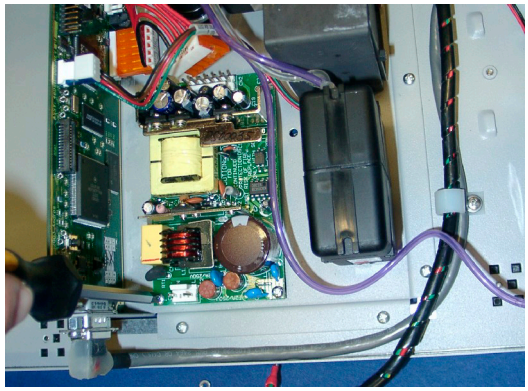


3 Remove the two screws securing the power supply cage.



4 Remove the power supply cage.

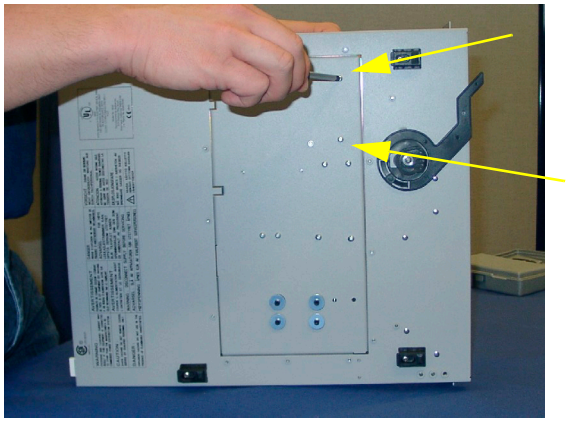
5 Remove the four screws to take out the power supply board.



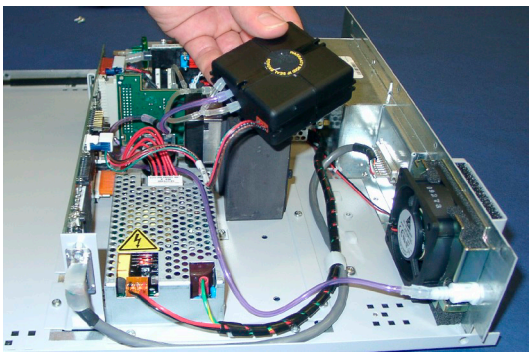
6 Follow the above steps in reverse order to replace the power supply.

Replacing the O_2 Cell

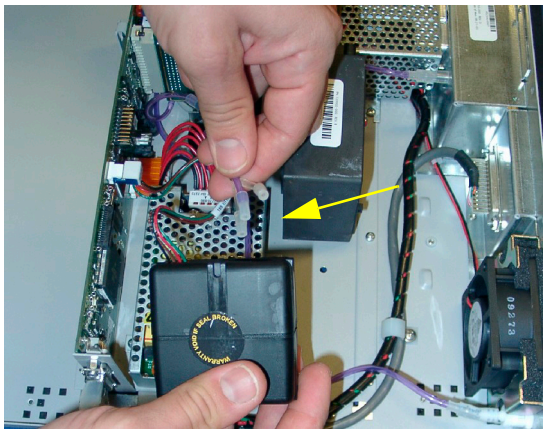
1 Remove the two screws securing the O_2 cell at the bottom of the Anesthetic Gas Module.



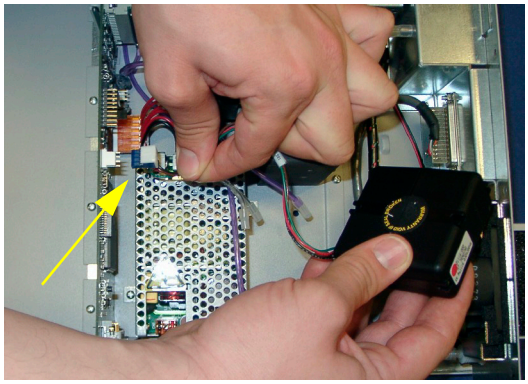
2 Lift out the O2 cell.



3 Remove the tubing from the O_2 cell.



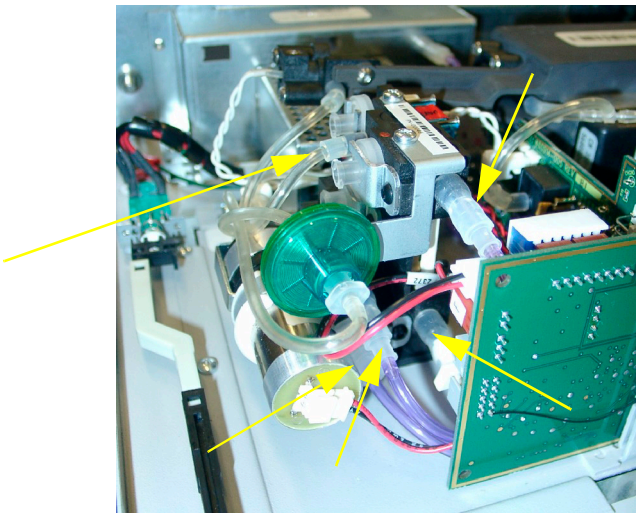
4 Remove the connector to the main PC board.



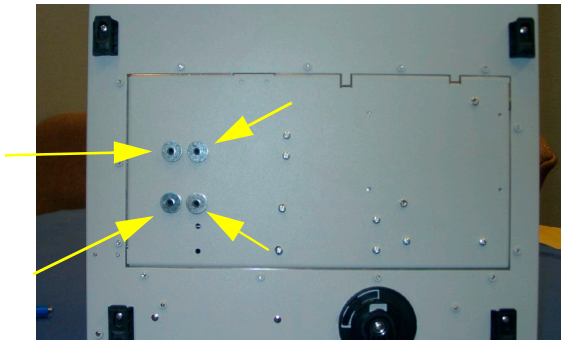
5 To replace the O_2 cell, follow the above procedure in reverse order.

Replacing the Pneumatic Assembly

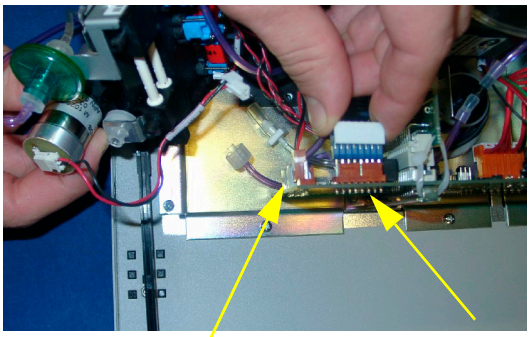
1 Remove the tubing from the pneumatic assembly.



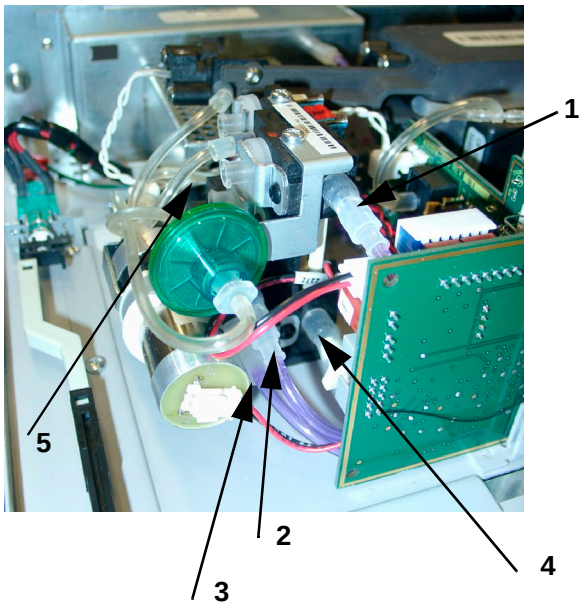
2 Remove the four screws securing the pneumatic assembly at the bottom of the Anesthetic Gas Module.



3 Lift up the pneumatic assembly and disconnect the solenoid connector and the pump connector to remove it completely.



4 Replace the pneumatic assembly making sure that the tubing is connected correctly.



1	Tubing to T-piece to dampening volume and differential pressure sensor
2	Tubing to zero gas outlet
3	Tubing to sample gas outlet
4	Tubing to differential pressure sensor
5	Tubing to sample cell inlet

NOTE Whenever the pneumatic assembly is replaced it is mandatory to perform a flow calibration.

7

Parts List

This chapter provides the replacement and exchange part numbers (if available) for the Philips M1026B Anesthetic Gas Module and calibration equipment. Refer the following table to identify the part and part number.

The circuit boards used in the Anesthetic Gas Module contain Surface Mounted Devices (SMD) which can only be repaired with special equipment, not available in the field. For this reason, the majority of the parts used in the system can only be replaced at board level.

Part Number	12NC Number	Description
M1026-60558	453563499671	New Exchange Unit
M1026-69558	453563499681	Repaired Exchange Unit
M1026-60193	451261000161	Power Supply
M1026-60194	451261000171	O2 Head
M1026-60192	451261000151	Pneumatic Assembly
M1026-60190	453563499651	Top Cover
M1026-60191	453563499661	Front Panel Overlay
M1026-60105	453563230431	Front Panel PCB
M1026-60106	453563230441	Fan, 12Vdc
M1026-60146	453563467211	Manifold Seals

Part Number of Kit	12NC Number	Description
M1026-60180	453563499641	Preventive Maintenance Kit. Includes: 4 bacterial filters 1 Pump outlet filter Pump tubing 2 fan filters 2 Watertrap manifold seals
M1026-60117	453563230541	Gas Inlet/Outlet Kit. Includes: Barb Retainer Nut Fitting 1/8 in. ID (4mm), Female inline coupling Fitting with nut, Panel Mount, Male coupling (2 pieces)
M1026-60133	453563230681	WT Manifold kit
M1026-60134	453563230691	WT Protector kit

Service Equipment

The following table lists the part numbers for the calibration equipment.

Part Number	12NC Number	Description
M1026-60144	453563230731	Electronic Flow meter
M1657B	989803110871	Watertrap
M1658A	989803104671	Sample Tubing
M1659A	989803104681	Calibration Tube Assembly
M1662A		Calibration Gas Assembly (2% Desflurane, 5% CO_2, 43% N_2O, 50% O_2)
M1026-61005		AGM -> PC cable
M1026-60136	453563230711	Flow Split Test Fixture

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